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SAVING LIVES AND MONEY
TWO WHEELS AT A TIME

by

Kavan O. Lake

March 2010

Thesis Co-Advisors: David R. Henderson
William D. Hatch

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In fiscal year 2008 motorcycle fatalities in the Navy and Marine Corps totaled more than combat fatalities for Sailors and Marines in both Iraq and Afghanistan. This study examines how motorcycle accidents and motorcycle training programs affect the mission and readiness of the Navy and Marine Corps. This study focuses on the impact motorcycle fatalities and injuries have on manpower, and addresses the monetary costs of accidents, and the costs of recruiting and training individuals for service in the Navy and Marine Corps. The study utilizes Navy and Marine Corps motorcycle accident data from fiscal years 2000 through 2008 to estimate the probabilities of a Sailor or Marine being killed or injured if he is involved in a motorcycle accident. Motorcycle accident information combined with recruiting and training information is used to estimate individual investments, in 2008 dollars, and monetized cost of motorcycle accidents for fiscal year 2008. The analyses indicate that individual recruiting and training may cost $25,000 to $170,000, depending on the occupational specialty, while individual motorcycle accidents may cost $22,000 to $400,000. Additionally, the findings indicate that the current approved motorcycle safety course may not provide all the skills needed to help Sailors and Marines become safer riders.

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SAVING LIVES AND MONEY
TWO WHEELS AT A TIME

Kavan O. Lake
Captain, United States Marine Corps
B.S., Florida State University, 2001

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Author: Kavan O. Lake

Approved by: David R. Henderson
Thesis Co-Advisor

William D. Hatch
Thesis Co-Advisor

William R. Gates
Dean, Graduate School of Business and Public Policy

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In fiscal year 2008, motorcycle fatalities in the Navy and Marine Corps totaled more than combat fatalities for Sailors and Marines in both Iraq and Afghanistan. This study examines how motorcycle accidents and motorcycle training programs affect the mission and readiness of the Navy and Marine Corps. This study focuses on the impact motorcycle fatalities and injuries have on manpower, and addresses the monetary costs of accidents, and the costs of recruiting and training individuals for service in the Navy and Marine Corps. The study utilizes Navy and Marine Corps motorcycle accident data, from fiscal years 2000 through 2008, to estimate the probabilities of a Sailor or Marine being killed or injured if he is involved in a motorcycle accident. Motorcycle accident information combined with recruiting and training information is used to estimate individual investments in 2008 dollars, and monetized cost of motorcycle accidents for fiscal year 2008. The analyses indicate that individual recruiting and training may cost $25,000 to $170,000, depending on the occupational specialty, while individual motorcycle accidents may cost $22,000 to $400,000. Additionally, the findings indicate that the current approved motorcycle safety course may not provide all the skills needed to help Sailors and Marines become safer riders.

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LIST OF ACRONYMS AND ABBREVIATIONS

AMA	American Motorcycle Association
AMOS	Advanced Motorcycle Operator School
BRC	Basic Rider Course
BRT	Basic Rider Training
CNA	Center for Naval Analysis
CONUS	Continental United States
CPI	Consumer Price Index
DMV	Department of Motor Vehicles
ERC	Experienced Rider Course
FIM	International Motorcycling Federation
MCRD	Marine Corps Recruit Depot
MCT	Marine Combat Training
MEF	Marine Expeditionary Force
MOS	Military Occupational Specialty
MRC: RSS	Motorcycle Rider Course: Rider and Street Skills
MSF	Motorcycle Safety Foundation
MSRC	Military Sport Bike Rider Course
NESBA	North Eastern Sport Bike Association
NHTSA	National Highway Traffic Safety Administration
ODOT	Oregon Department of Transportation
PMOS	Primary Military Occupational Specialty
RCT	Recruit Training Command
SGLI	Servicemembers' Group Life Insurance
TSGLI	Traumatic Injury Protection Under Servicemembers' Group Life Insurance

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I. INTRODUCTION

A. BACKGROUND

The Marine Corps has approximately 17,800 registered motorcycles riders on its installations worldwide, while the Navy has approximately 30,100 registered motorcycle riders on its installations all over the world. Approximately 50 percent of all registered riders in the Marine Corps operate sport bikes. About 9,900 sport bike riders in all. In comparison, about 30 percent of all registered riders in the Navy operate sport bikes. Approximately 11,700 sport bike riders. While only about half the riders registered in the Navy and Marine Corps are sport bike riders, sport bikes claim over 80 percent of all reported motorcycle accidents and fatalities in the both of these services. Despite initiating several measures in the form of rules and regulations, and mandatory motorcycle safety training, the number of accidents and fatalities has continued to climb until the end of fiscal year 2008. Twenty-five Marines and 33 Sailors lost their lives in motorcycle accidents in 2008. These two figures are the highest number of motorcycle fatalities both services have seen since 1999. Fiscal year 2008 motorcycle fatalities in the Navy and Marine Corps totaled more than combat fatalities for Sailors and Marines in both Iraq and Afghanistan. Since sport bikes are extremely popular within the ranks of both services, motorcycle incidents are not anticipated to decline unless changes are implemented.

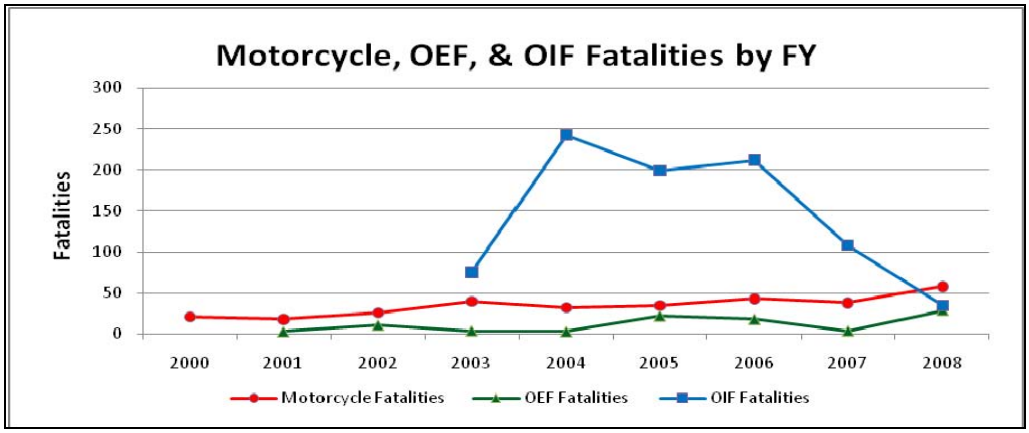

Figure 1. Navy and Marine Corps Motorcycle OIF, and OEF Fatalities by Year

On average, the sport bike manufacturers change the design of the motorcycles they produce every two years. The changes in design will not only incorporate sleek, new aerodynamic body styles, but very often will also include the newest technology developed by the manufacturers from the last two years of racing. The technology will normally include improved handling and stability, better acceleration, and improved power-to-weight ratio, all of which are desirable upgrades in the hands of a trained professional. Manufacturers bring race bike technology to the street production models in an effort to outdo competitors, because the consumer is always looking to purchase what he consider the best sport bike. The result is a faster, lighter, more powerful sport bike that any military member can purchase right off the showroom floor of any dealership.

Both services recognize the high risk associated with riding a sport bike, and seek to curtail the accidents and fatalities by means of rules, regulations, and training. But there may be a fundamental flaw related to the type of training sport bike riders receive prior to riding a motorcycle. Furthermore, statistics from the Naval Safety Center indicate that 55 percent of all Sailors and Marines killed in motorcycle accidents in 2008 had completed some form of motorcycle course prior to operating a motorcycle. A large proportion of all narratives in motorcycle accident reports point to "loss of control" as a major factor in the accidents' occurrence. Recently, both services have implemented the Military Sport Bike Course as a new tool to prepare sport bike riders to better handle their motorcycles. Despite recognizing the risks that sport bikes pose to Sailors and Marines who purchase and ride sport bikes, there has been little analysis done on the effect of motorcycle accidents on mission readiness in the Navy and Marine Corps.

One particular problem associated with Sailors and Marines being injured or killed in motorcycle accidents is that the services will be unable to gain a full return on investment after investing millions of dollars to recruit and train personnel for various military occupational specialties. Injuries and fatalities add up to substantial loss of manpower and accrual of hefty monetary costs to the Navy and Marine Corps.

B. PURPOSE

The purpose of this research is to examine how motorcycle accidents and motorcycle training programs affect the mission and the readiness of the Navy and Marine Corps. This thesis is an examination of the main causes of motorcycle accidents in the Navy and Marine Corps, and examines possible beneficial training solutions to both the services and riders. One objective is to estimate the probability that a Sailor or Marine who has completed an approved motorcycle safety course will get into a serious accident compared to the probability for another service member who has not taken such a course. The primary research question is the following: How do motorcycle accidents affect mission readiness in the Navy and Marine Corps? The objective of this analysis is to help Navy and Marine Corps decision makers incorporate effective motorcycle safety training that decreases the number of accidents and fatalities in the Navy and Marine Corps.

Research Questions

Primary:

1. How do motorcycle accidents affect mission readiness in the Navy and Marine Corps?

Secondary:

1. What are the primary causes of accidents in the Navy and Marine Corps?
2. How are Sailors and Marines selected for training for motorcycle training courses?

C. METHODOLOGY AND SCOPE OF THE STUDY

This study examines the factors that contribute to motorcycle accidents and fatalities in the Navy and Marine Corps, and performs statistical analysis of motorcycle accident data in an effort to determine if the current motorcycle safety training programs

play a significant factor in reducing motorcycle accidents. A probit model is utilized to determine the probability of a Sailor or Marine being involved in a motorcycle accident that renders a fatal or incapacitating injury.

In addition, a cost benefit analysis is conducted to determine the cost of recruiting and training Sailors and Marines, the cost of life insurance and hospitalization after an accident, and the cost of a course to replace or supplement the current motorcycle safety program.

D. BENEFITS OF THE STUDY

The goal of this study is to provide the Navy and Marine Corps with a better understanding of how motorcycle accidents affect manpower readiness, and provide a framework on which to implement changes to motorcycle safety programs for the benefit of the services, and Sailors and Marines.

E. ORGANIZATION OF THE THESIS

Chapter II reviews the literature that is applicable to establishing a framework from which to discuss prior studies, the findings as they relate to motorcycle accidents, and motorcycle accident outcomes. Chapter II also discusses Department of the Navy policy and the current approved motorcycle safety training. Chapter III presents the data and methodology used to analyze the effects of motorcycle accidents on manpower readiness in the Navy and Marine Corps. Chapter IV presents and examines the analyses and results related to the effect of motorcycle accidents in terms of manpower readiness and financial cost. Chapter V provides a summary, conclusion, and recommendations.

II. LITERATURE REVIEW

A. OVERVIEW

The increasing number of motorcycle accidents and fatalities in the Navy and Marine Corps poses a serious problem for both services. The increase in accidents and fatalities involving service members mimics trends of motorcycle accidents and fatalities in the civilian population. The rising cost of manpower throughout the Department of Defense makes dealing with service members injured or killed in motorcycle accidents extremely expensive not only financially, but also in terms of manpower and readiness. Implementing changes to the current policy and motorcycle training courses throughout the Navy and Marine Corps could provide significant benefits to the services, and health and welfare of Sailors and Marines. Better training should translate into fewer accidents, and the Navy and Marine Corps will benefit from more readily available manpower and monetary savings. This chapter reviews prior motorcycle crash studies, motorcycle accident trends that involve service members, and the current problem today's military faces in terms of motorcycle accidents. Additionally, this chapter reviews how motorcycle changes, deployments, and motorcycle safety training affect a Sailor's or Marine's probability of being involved in a motorcycle accident.

B. PRIOR MOTORCYCLE ACCIDENT STUDIES

One of the most significant motorcycle safety studies ever conducted, was done by Hurt, Ouelett, and Thorn (1981) at the Traffic Safety Center of the University of Southern California, Los Angeles. This study was conducted at the request of the National Highway Traffic Safety Administration in an attempt to identify the causes of motorcycle accidents and fatalities that were on the rise at an alarming rate. The study, titled *Motorcycle Accident Cause Factors and Identification of Countermeasures*, was conducted between July 1975 and September 1980, and included more than 900 on-scene accident investigations, and over 3,600 police accident reports. Some of the significant findings of Professor Hurt's motorcycle accident study are highlighted in Table 1.

Table 1. Motorcycle Accident Study Findings (After Hurt, 1981, p. 416)

- Twenty-five percent of the motorcycle accidents were single vehicle accidents involving collision with the roadway or fixed objects.
- In the single vehicle accidents, rider contributed in 66% of the cases.
- Typical accident error was over braking or running wide in a curve leading to a fall.
- More than half the accident-involved riders had less than five months experience on the accident motorcycle.
- Motorcyclist had less than two seconds to maneuver to avoid accident.
- The likelihood of injury is extremely high; 98% in multiple vehicle accident, 96% in single vehicle accident, and 45% resulting in more than minor injury.
- Deadliest injuries were to the chest and head.
- Motorcycle riders with previous traffic citations and accidents were overrepresented in the accident data.

Based on the findings of the study, the author concluded that "lack of training was a significant factor in accident involvement" and that there was a need for a "specialized" motorcycle safety course to curtail the increasing accident and injury trend that plagued that decade (Hurt, Ouelett, & Thorn, 1981, p. 419). Interestingly, the Motorcycle Safety Foundations Basic Motorcycle Rider Course was named as one of the most effective countermeasures in fixing the problem. Much has changed over the last 25 years with regard to the motorcycles people are riding today. However, no other individual or organization has conducted a more intensive study than the one presented by Professor Hurt in 1981.

The fact that no recent study of such a depth has been completed raises the question of whether the Motorcycle Safety Foundations Basic Rider Course still qualifies as the most effective countermeasure for motorcycle accidents, injuries, and fatalities, especially since motorcycles have changed so much over the past two decades. Owing to a nationwide rise in motorcycle accidents and fatalities in the late 1990s, the Federal Highway Administration commissioned the Oklahoma Transportation Center at Oklahoma State University to conduct a new motorcycle accident study in 2005. The study is still ongoing as of October 2009 (Kunitsugu, 2010, p. 8).

Between 2001 and 2004, the state government of Oregon completed a series of studies that were aimed at evaluating the Motorcycle Safety Foundation's (MSF) newest entry level Basic Rider Course and Oregon's own entry level Basic Rider Training. The evaluation was sanctioned due to the Motorcycle Safety Foundation's decision to replace the entry level Motorcycle Rider Course: Riding and Street Skills (MRC: RSS) with the current Basic Rider Course (BRC). One purpose of these studies was to identify the strengths and weaknesses in Oregon's Basic Rider Training (BRT), and compare the Motorcycle Safety Foundation's Basic Rider Course to Oregon's Basic Rider Training. TEAM OREGON, an organization developed in part by the Oregon Department of Transportation and Oregon State University, was responsible for conducting the study. The study compared the MSF's BRC to Oregon's BRT, while using the MSF's MRC: RSS as a benchmark. Based on the findings of TEAM OREGON's study, the organization made the following recommendations.

> It was the unanimous recommendation of the task force that TEAM OREGON not adopt the BRC (classroom or range) as presented. This recommendation and a full report were provided to the Oregon Department of Transportation in November of 2002. Based on the findings of the field test, ODOT concluded that the BRC was not an appropriate curriculum for the novice riders of Oregon (and would not make a suitable replacement for the MRC:RSS) and directed TEAM OREGON to not adopt the BRC as presented. (Axman Consulting Inc., 2004, p. 8)

In the final report published in March 2003, Steve Garets, the Director of Team Oregon, made the following assessment.

> The BRC has many positive attributes. However, as presented it lacks adequate focus, priority and RiderCoach guidance. The classroom portion fails to adequately address the needs of riders on Oregon's streets and highways. More skill development emphasis is needed to address the skills identified as lacking in the accident-involved rider; specifically the treatment of head and eyes, cornering and traffic interaction. These issues must be addressed and cured before TEAM OREGON can recommend adoption of this curriculum.
>
> TEAM OREGON recommends that ODOT not adopt this curriculum until the issues and concerns listed are addressed and adequately tested. (Garets, 2003, p. 9)

The recommendations by Team Oregon on the implementation of the MSF's BRC raise questions on the validity and adequacy of the BRC as a course for novice motorcycle riders. Even though the MSF's BRC was rejected by Oregon, it is accepted by numerous other states as a waiver to the state motorcycle road test.

C. OTHER STUDIES

Other studies related to motorcycle accidents look at the cost for hospitalization and rehabilitation. A 1996 report on hospitalization cost for motorcycle accidents in the state of Washington estimated that the average length of hospitalization for motorcycle accident victims was approximately 10 days, with an average cost of $12,689 in 1989 dollars (Rowland et al., 1996, p. 43). A separate study conducted in 2006 estimated that the average cost of hospitalization for motorcycle accident victims was $17,557 in 2002 dollars (National Highway Traffic Safety Administration, 2006, p. 41). Regardless of which study is analyzed, the monetary costs for hospitalization and rehabilitation associated with motorcycle injuries will be substantial in almost all instances.

D. DEFINING THE PROBLEM

For years, fascinating high-powered motorcycles have always been the recreational vehicle of choice for service members of all types. This same fascination leads numerous service members to become owners of the high-powered machines, some far too powerful for their owners to handle, and many more even too powerful for the street. This fascination with the high-powered motorcycles is not expected to diminish in the near future, and motorcycle ownership among military members is not expected to decline. Furthermore, rising gas prices between 2006 and 2007, and fluctuating gas prices during most of 2008 and 2009 may be a factor related to more military members riding sport bikes. Many military members purchase sport bikes for the thrill of riding, and many more purchase for the convenience of a cheaper alternative to having multiple cars in a family. Other military members purchase sport bikes for both of the aforementioned reasons. Regardless of the reason or reasons for purchase, the growing

popularity of sport bikes in the Navy and Marine Corps, and the increasing rate of accidents and fatalities, command the attention of top military leadership and Congress.

The main problem facing motorcycle riding service members today is that there is a very high and ever increasing rate of accidents associated with high-power motorcycles. Higher accident rates lead to higher fatality rates, higher motorcycle accident injury rates, and higher disability rates for military services. This will inevitably lead to higher financial and manpower costs for the Navy and Marine Corps if nothing is done to reduce the increasing rate of motorcycle accidents throughout both services. The Naval Safety Center motorcycle accident data revealed that 246 Sailors and 123 Marines were either killed or seriously injured in motorcycle accidents in 2008 alone. The data also indicate that 87 percent of the Sailors and Marines killed or injured in motorcycle accidents in 2008 were riding sport bikes.

Some leaders see the combination of young service members and motorcycles as a recipe for disaster. Leadership intuition often is correct, as the results of such a combination leave service members hospitalized, permanently disabled, or fatally injured. All the stated injury categories cost the military vast amounts of time, money, and effort, which are critical assets that could be used elsewhere for training and equipping the military for combat operations. Naval Safety Center motorcycle accident data indicate that in fiscal year 2008 alone, 246 Sailors and 123 Marines were injured or killed in motorcycle accidents. One hundred and twenty-three Marines seriously injured or killed in motorcycle accidents amount to approximately four platoons of various military occupational specialties unable to perform their jobs. Out of a company of six platoons of Marines, the equivalent of two-thirds of the entire company is incapacitated due to motorcycle accidents. Navy figures are even more staggering. Essentially, motorcycle riders are becoming one of the military's biggest liabilities. Obviously, riders are not mounting their machines with the intention of maiming themselves or ending their lives. Most motorcycle riders intend to have a good time and enjoy some of the freedom that can be satisfied only with an exhilarating ride on a powerful two-wheeled machine.

While military and civilian riders share a great number of similarities in demographics, one main variable that separates the two communities is time spent on the

motorcycle. Military members may spend significantly less time on their motorcycles due to training evolutions, deployments, and other work commitments. The increasing rate of motorcycle accidents is not only affecting the military services, but is also affecting motorcycle riders across the United States. The annual motorcycle accident and fatality rates in the United States continue to increase and, in 2006, surpassed the number of pedestrian fatalities for the first time since 1975, when the National Highway Traffic Safety Administration (NHTSA) started collecting motorcycle accident statistics (United States Department of Transportation, 2007, p. 3).

This increase in motorcycle accident rate affecting both the military and civilian community may be a combination of the type of training a rider receives and the type of motorcycle the rider decides to purchase. Although the military and civilian rates of motorcycle accidents and fatalities increased over the last several years, there is not a vast amount of research conducted to determine whether the motorcycle training being offered to motorcycle riders is sufficient for them to handle the motorcycles they purchase. This may be especially important with regard to sport bikes, which are extremely popular within the military ranks. Motorcycle riders around the nation, military and civilian, all go through similar training based on a curriculum provided by the Motorcycle Safety Foundation (MSF). While the MSF has remained the main instructional institution for motorcycle safety training, the training curriculum itself has seen minimal changes over the past several years, while the sport bikes that are being purchased and ridden by our service members today have seen changes almost every two years. Some changes are more dramatic than others. Each time a high-powered sport bike is changed, the result is better technology and a lighter, faster, more-powerful machine capable of reaching speeds of over 100 miles per hour in just a few seconds. The motorcycles themselves have evolved immensely, while the motorcycle training offered through the Motorcycle Safety Foundation has remained relatively stagnant.

Two questions need to be discussed at this point. First, why are motorcycles getting lighter, faster, and more powerful all the time? Second, why has the Motorcycle Safety Foundation safety course remained relatively stagnant over the years?

To answer the first question, we need to understand that the motorcycle manufacturers are in the business to maximize their profits through the sale of motorcycles. The sport bikes we see today on the showroom floor of any dealership were built for one main purpose. They are modeled after the latest race bikes, and were built as racing platforms to win races; therefore, they get lighter, faster, more powerful, and more agile with each new design. A sport bike can normally be expected to be redesigned every 2 years. Adding to the aforementioned characteristics, the newest motorcycles on the showroom floor all have the latest technology trickled down from the latest (sometimes prototype) racing machines used in the previous racing season. These racing machines are piloted by highly skilled, professionally trained, seasoned racers. Most of these professionals have been riding motorcycles from a very early age, some as early as 5 years old, and the machines they ride are purpose built for each individual rider.

Professional riders all navigate racetracks in slightly different ways unnoticeable to the average person. They each have a certain way they attack a corner, or apply the brakes and transition to the throttle. There is no perfect way for a professional racer to ride faster than a competitor, but they all have good equipment, and they know their machines through and through. They also have the capability to adjust to any motorcycle in any riding condition. The rule in motorcycle racing is "Win on Sunday, sell on Monday." In order to win races each year, each sport bike manufacturer is always looking to stay one step ahead of their competitors. This means designing and building a lighter, faster, more powerful motorcycle capable of winning races. Development on the motorcycles continues all year long. Anything discovered on one race day will eventually find its way to the showroom models in subsequent years. The average rider (military riders included) will usually want to acquire the latest model sport bike after the manufacturers tout the number of championships won by that particular model. Other factors that attract buyers and enthusiasts include appearance, color, styles, availability, price, and popularity of each individual motorcycle model. Sport bike manufacturers build light, fast, powerful sport bikes to win races, and winning races sells machines.

The second question is not as straightforward. Why have motorcycles continued to evolve at an extremely fast rate, while the motorcycle training courses have not?

The Motorcycle Safety Foundation is sponsored by the motorcycle manufacturers, and provides the basic and experienced level motorcycle training to riders all over the United States. Again, we must specifically be reminded that the main goal of the manufacturers is to make a profit in the sales of motorcycles. Motorcycles continue to evolve because of the racing industry, and the need for manufacturers to win championships and titles. As mentioned before, winning races and titles will lead to more motorcycle sales, because winning a title tells a would-be customer that a particular manufacturer has found the winning solution, otherwise known as the best sport bike at that moment. The sport bike manufacturers have found a way to bring people to purchase motorcycles, by ensuring a course is available easy enough to almost guarantee licensing. Most people know this course as the Basic Riders Course (BRC).

In general, the Basic Riders Course (BRC) is 14 to 15 hours of combined classroom and practical instruction. MSF satellite agencies nationwide often advertise a BRC passing rate above 90% on average (Alpha Training Center, n.d., FAQ section, para. 6). One could challenge whether the manufacturers' motive for sponsoring the motorcycle safety courses is to make a rider better, or whether safety is the manufacturers' general concern. In answering that question, we need to fully understand why the requirements to successfully complete the motorcycle safety courses are so easy. The basic rider course is mainly designed to give a new, inexperienced rider the basic skills to operate a motorcycle. This means that the course clearly includes how to turn a motorcycle on and off and how to get it going, change gears, turn and maneuver. In most cases, instruction is completed in an area about the size of a large parking lot at speeds of approximately 30 miles per hour. Within a few days, a person who has no experience with motorcycles can complete this course and go to the DMV and get a motorcycle license, and may legally purchase and ride any type of motorcycle in almost all the states in the United States. This same motorcycle safety course is the required course for United States military personnel, in order to operate a motorcycle on and off military installations. One could infer that the Motorcycle Safety Foundation (MSF) course was

designed to allow a person to get his or her license easily after learning the basic operations. More motorcycle licenses will most likely lead to more motorcycle sales around the country, which may translate to profits for the motorcycle manufacturers. One could also infer that the real motive behind the manufacturers sponsoring the MSF course is not safety, but to generate profit by allowing people to acquire motorcycle licenses easily. As previously mentioned, the MSF claims that the BRC passing rate is better than 90%. It is likely that if the MSF course is made more difficult, then a higher percentage of people are likely to fail. This point is emphasized through the study conducted by TEAM OREGON in 2004, when the organization opted not to endorse the MSF's Basic Rider Course (BRC) in its current form.

Recently, the MSF moved to defend its position as the sole motorcycle training organization across the United States. In 2006, the MSF sought legal action against TEAM OREGON Rider Safety Program, claiming that the Oregon organization had infringed on copyright material that belonged to the MSF. A large percentage of the material used by the MSF had been originally developed by states before the MSF began using it in their courses. The state of Oregon had originally rejected the MSF BRC under the premise that it did not satisfy the needs of Oregon riders. The lawsuit enraged the motorcycle safety community, including motorcycle safety instructors who were beginning to suspect that the MSF was no longer focused on its mission statement, and had become an industry-sponsored profit center. The motorcycle safety community viewed the lawsuit as the MSF's attempt to stamp out any competition. In May 2008, the lawsuit was settled and TEAM OREGON was authorized to institute their motorcycle safety program, the Basic Rider Training (BRT) (webBikeWorld, 2009). The state of Idaho has taken similar actions.

In its current form, the Basic Riders Course offered under the Motorcycle Safety Foundation curriculum serves its purpose, which is to create a basic rider capable of passing a riding test to acquire a motorcycle license, and in doing so, generates new sales for the motorcycle manufacturers. The MSF's BRC may not be the best course for sport bike riders if rider safety is the greatest concern.

The intention here is not to point the finger at the MSF or the motorcycle manufacturers, or to blame them for the increasing number of motorcycle accidents and fatalities. It is not the motorcycle manufacturers' responsibility to ensure that all riders get the required training. After all, the car manufacturers are not responsible for ensuring that the drivers of their vehicles have taken driver's education. Therefore, it is fair to point out that even if the motive is to generate profits through new motorcycle licenses, the motorcycle manufacturers have gone a step further by at least providing a basic foundation for new and inexperienced riders. One motorcycle manufacturer, Yamaha, offers sport bike riders the opportunity to ride, under strict supervision, on a racetrack at no cost with the purchase of a new Yamaha sport bike (North Eastern Sportbike Association, Yamaha Alliance section, n.d.). The point is that if the MSF BRC course does not satisfy the needs of riders in the states of Oregon or Idaho, then the MSF BRC may not be the right course for military riders, either.

1. Department of the Navy Motorcycle Policy

Service members who desire to ride a motorcycle on a military installation or on public streets and highways are required to complete an approved motorcycle safety course. Service members can take the motorcycle safety course offered on their parent installations, or take the course at any MSF affiliated certified safety school. Both courses are identical and follow the MSF curriculum. The current Navy and Marine Corps regulations direct all riders, regardless of the type of street bike they operate, to complete the MSF's novice Basic Rider Course. Sport bike riders are then directed to take the Military Sport Bike Rider Course (MSRC) within 60 days of completing the BRC or the purchase of a sport bike. Other street bike operators are encouraged to complete the Experienced Rider Course (ERC) as soon as possible, or within 3 years of completing the BRC. Additionally, Navy and Marine Corps regulations direct all motorcycle operators to continue enhancing their skills by completing approved follow-on motorcycle safety training (ERC, MSRC) at least every 3 years (Department of the Navy, 2008, pp. 14–15).

Several issues arise when reviewing the current Department of the Navy motorcycle safety policy. First, the Basic Rider Course has the initial benefits of helping a rider understand the basics of riding a motorcycle and getting comfortable with controlling a motorcycle at relatively low speeds. The Military Sport Bike Rider Course enhances a rider's skill level by providing drills tailored for sport bikes at higher speeds than the BRC. However, the speeds at which each course is conducted are still relatively low compared to speeds on public streets and highways. The fear is that while both courses provide a good foundation, neither course may provide the necessary skill set to reduce the probability of a Sailor or Marine being involved in an accident. At a certain comfort level (assuming 3 to 6 months of experience), riders may develop a false sense of security in relation to their riding skills and the capability of their sport bikes. Based on Professor Hurt's finding that "more than half the accident-involved riders had less than 5 months experience on the accident motorcycle," it is fair to assume that the majority of new sport bike riders will have their first accident within the first 3 to 6 months of the initial purchase date (Hurt et al., 1981, p. 417). This includes those minor accidents that the rider may not report to their parent commands.

Second, sport bike riders will gain valuable knowledge and skills when they complete their initial BRC and MSRC. Repeating the course 3 years later may not add any value to the riders' learning curve, because it does not build on the skills they already have. The skill-set drills are simply repeated. In this case, the MSRC can potentially become a check in the box for those riders who have already completed it, and potentially waste valuable time, manpower, and money in the process.

Third, the ERC is simply another version of the Basic Rider Course with a few minor changes. Again, as in the case the MSRC, there is very little value added to the skills that the riders have already acquired. In both cases, the fear is that if riders perceive that they are not acquiring new skills, they simply complete the course to fulfill a requirement, and may not necessarily take the training seriously.

A fourth related issue is deployment schedules. In most cases, the military attempts to give Sailors and Marines at least 12 months between deployments. Within those 12 months in the continental United States (CONUS), service members will spend

several of those months preparing for the next deployment. A Sailor or Marine who has completed the BRC may desire to ride his/her motorcycle up until a week prior to a deployment. As an example, let us assume that a Marine completes the BRC and MSRC in December 2007. Let us also assume that this Marine will deploy from January 2008 till July 2008. Upon return from deployment, after being off the motorcycle for 7 months, this Marine is not required to attend a refresher course until December of 2010. The main problem here is that this Marine may not recognize that his/her riding skills have deteriorated over the past 7 months, but still has 2 years and 5 months before he or she is required to attend another refresher course. There is a very high probability that this Marine will want to ride his/her motorcycle after a long deployment. The same can be true in the case of a Marine who has completed the ERC, deploys for a year, and returns with 2 years of "legal rider eligibility." This rider may be in a worse position than the rider in the first case because of the longer period off the motorcycle. The period following the completion of a deployment (0–60 days) is a critical time period for the riders in each case. The current policy does not address the motorcycle training requirement at the completion of a deployment, when a rider may be most vulnerable to being involved in a motorcycle accident. This may be the single most critical flaw associated with the current policy.

2. Current Motorcycle Accident Trends

Naval Safety Center motorcycle accident data indicate that over the past 10 years, both the Navy and Marine Corps have suffered from an increasing rate of motorcycle accidents and motorcycle related fatalities. The increasing rate is based solely on the number of reported accidents and fatalities each fiscal year. This trend is not only prevalent among military riders, but is also evident in motorcycle accident and fatalities across the entire United States. The National Highway Traffic Safety Administration reported that motorcycle fatalities have almost doubled between 1999 and 2006, from 2,493 in 1999, to 4,810 in 2006. The number of motorcycle fatalities reported in 2008 was 5,290, a 113 percent increase since 1999 (National Highway Traffic Safety Administration, 2008, p. 1). Table 2 shows the nationwide motorcycle fatality statistics.

Table 2. National Motorcycle Fatality Statistics (After the National Highway Traffic Safety Administration, 2008, p. 1)

National Motorcycle Fatalities by Year										
Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Motorcycle Fatalities	2,483	2,897	3,197	3,270	3,714	4,028	4,553	4,810	5,154	5,290
% Change	8.2	17.0	10.0	2.3	14.0	8.5	13.0	5.0	6.6	3.0

Most states require that motorcycle riders complete the Motorcycle Safety Foundation's (MSF) Basic Rider Course (BRC) to legally operate a motorcycle on the streets and highways. This increasing nationwide trend may suggest an increasing ineffectiveness of the MSF's BRC, especially when considering the technological changes motorcycles have undergone. The main connections between military and civilian riders are the motorcycles they ride, and the courses riders complete to ride legally on public streets.

While it is easy to concentrate on motorcycle fatalities in the Navy and Marine Corps, we need to focus on the bigger picture. Fatalities are only one portion of the problem that directly affects manpower. Between fiscal years 2000 and 2008, fatalities accounted for 13.29 percent of all motorcycle accidents. During that same period motorcycle accidents that resulted in permanent or partial disability injuries, or other injuries requiring time off from work, accounted for a combined 60.33 percent of all the observations.

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III. DATA AND METHODOLOGY

A. OVERVIEW

This chapter presents the data and the methodology used to analyze the effects of motorcycle accidents on manpower readiness in the Navy and Marine Corps. The analysis is conducted by estimating the probability of a Sailor or Marine who has completed an approved motorcycle safety course being involved in an accident resulting in fatality or injury. The data also is used to analyze the cost and the benefits of providing a motorcycle safety course that differs significantly from the current course. The first section discusses the data and methodology used to determine a military rider's probability of getting into a motorcycle accident. The second section discusses the data and methodology of calculating the costs associated with recruiting and training one individual for service in the Navy or Marine Corps. The third section discusses the data and methodology of calculating the cost to the Navy and Marine Corps when a Sailor or Marine is injured or killed in a motorcycle accident.

B. PROBABILITY ESTIMATION

This section presents the data and methodology used to estimate the probability of a Marine or Sailor getting into a fatal motorcycle accident or having a motorcycle accident that results in injuries that keep them from performing their jobs. This discussion and corresponding analysis address the primary thesis research question: How do motorcycle incidents affect mission readiness of the Navy and Marine Corps?

This section is organized in two subsections: the data and the probability estimation methodology.

1. The Data

The author used pooled Navy and Marine Corps data provided by the Naval Safety Center of reported motorcycle accidents from fiscal year 2000 through fiscal year 2008. The data is separated by service, but is combined for the purpose of performing

regression analysis. The data covers reported accidents that range from no injury to the rider to accidents resulting in rider fatality. For each observation the data includes demographic information, date and location of accident, motorcycle type, mishap classification, and whether or not the subject had completed a motorcycle training course. The data also provides information on various levels of experience, and whether the individual Sailor or Marine involved in a motorcycle accident was absent from work for any particular time as a result of the accident. The data is assembled from 1,600 observations for the Navy and over 900 observations for the Marine Corps.

Since the data only present reported motorcycle accidents, the total number of observations represents a very small fraction of the entire Navy and Marine Corps motorcycle community. The probit analysis is solely dependent on a Sailor or Marine being involved in a motorcycle accident, and the estimated probabilities are strictly confined to this dataset. The results of the probit regression are not expected to provide a strong representation of the entire Navy and Marine Corps motorcycle community. However, the probit regression results are used to provide a snapshot of the possible outcomes of motorcycle accidents involving Sailors and Marines.

2. Probability Estimation Methodology

A probit model is used in estimating the probability of a Sailor or Marine being involved in a motorcycle accident that results in injury or fatality. A probit model is a non-linear regression model where the predicted values of the dependent variables are strictly constrained between 0 and 1. It is used to estimate the probability of a dependent variable (y) occurring given that certain observed independent variables (x_1, x_2, x_3,…x_k) exist. A probit model is written as: $P(y=1|x) = \Phi(x\beta)$, where Φ is a cumulative standard normal probability distribution, and $(x\beta)$ is the product of the parameters and the observed independent variables (Wooldridge, 2006, pp. 575–576). The derivation of the probability is illustrated below.

$\Pr(y=1|x) = G(\beta_0 + x\beta)$, where $0<G(z)<1$.
$G(z) = \Phi(z) \equiv \int \varphi(v)dv$, where G is the standard normal cumulative distribution function.
$\varphi(z) = (2\pi)^{-1/2}\exp(-z^2/2))$, where $\varphi(z)$ is the standard normal density.

A probit model utilizes a maximum likelihood estimate, which is based on a simple principle: choose parameters that would maximize the probability of our dependent variables. In the case of this thesis, the separate dependent variables are *fatality* and *miss work* as a result of a motorcycle accident. By utilizing a probit model, the intent was to use the observed independent variables to estimate the likelihood of a Sailor or Marine being killed or seriously injured if he or she is involved in a motorcycle accident. The probit model is also intended to capture the role each observed independent variable plays in reaching the final probability of fatality or injury if a Sailor or Marine is involved in a motorcycle accident. Each observed independent variable affects the dependent variables in different degrees. The probit regression will show the partial effect, or change, that each independent variable has on the outcome of the independent variables.

For this probability estimation, two separate probit equations are developed. The first is used in determining if a Sailor or Marine who has completed an approved motorcycle safety course is involved in a motorcycle accident, what will be the probability of that Sailor or Marine being killed. The second equation is used in determining if a Sailor or Marine who has completed an approved motorcycle safety course is involved in a motorcycle accident, what will be the probability of missing work due to injuries. The specifications for the theoretical models to estimate the probabilities of a Sailor or Marine being killed or injured in a motorcycle accident are as follows:

$$P(\text{Fatality} \mid x) = G(\beta 0 + \beta 1(\text{sport\_bike}) + \beta 2(\text{trng\_cmpltd}) + \beta 3(\text{summer}) + \beta 4(\text{spring}) + \beta 5(\text{south}) + \beta 6(\text{west}) + \beta 7(\text{jr\_offcr}) + \beta 8(\text{jr\_enlsd}) + \beta 9(\text{staff\_enlsd}) + \beta 10(\text{age}) + \beta 11(\text{fy\_2008}))$$

$$P(\text{Miss Work} \mid x) = G(\beta 0 + \beta 1(\text{sport\_bike}) + \beta 2(\text{trng\_cmpltd}) + \beta 3(\text{summer}) + \beta 4(\text{spring}) + \beta 5(\text{south}) + \beta 6(\text{west}) + \beta 7(\text{jr\_offcr}) + \beta 8(\text{jr\_enlsd}) + \beta 9(\text{staff\_enlsd}) + \beta 10(\text{age}) + \beta 11(\text{fy\_2008}))$$

where all variables are defined in Table 3

Table 3. Description of Probit Model Variables

Definition of Variable		
Dependent Variables	**Variable Description**	**Variable Type**
Fatality	Fatal injury as a result of a motorcycle accident.	Binary
Miss Work	Missed work for a particular amount of time due to injuries sustained in a motorcycle accident. Category includes fatalities, injuries, and disabilities.	Binary
Independent Variables	**Variable Description**	**Variable Type**
Sport Bike	Sport bike involved in the motorcycle accident.	Binary
Training Completed	Approved motorcycle safety training course was completed.	Binary
Summer	Accident occurred in the Summer season.	Binary
Spring	Accident occurred in the Spring season.	Binary
South	Accident occurred in a southern location.	Binary
West	Accident occurred in a western location.	Binary
Junior Officer	Service member involved in accident between the pay-grade of O-1 to O-3.	Binary
Junior Enlisted	Service member involved in accident between the pay-grade of E-1 to E-5.	Binary
Senior Enlisted	Service member involved in accident between the pay-grade of E-6 to E-9.	Binary
Age	Service members' age.	Interval
Fiscal Year	Fiscal year of accident occurrence.	Binary

C. SERVICE INVESTMENT COST ESTIMATION

This section presents the data and methodology used to estimate the cost of recruiting and training Sailors and Marines for their various military occupational specialties (MOSs).

1. The Data

Navy and Marine Corps commands provided the costs associated with recruiting and basic training. A 2004 cost-benefit analysis, conducted by the Center for Naval Analysis (CNA), provided MOS training costs for select military occupational specialties.

The author selected six military occupational specialties for each service from the CNA study that provided a wide range of cost estimates for training individual Sailors and Marines.

2. Investment Cost Estimate

The cost of training Sailors and Marines for their military occupational specialties in 2008 was updated using a Consumer Price Index (CPI) equation. The CPI equation converted the 2004 constant dollar cost for the MOSs specified in the CNA study, to constant dollar costs for 2008. In determining the total investment for the selected MOSs, the 2008 training costs is added to the 2008 recruiting costs. Formula 1 shows the equation used in determining individual investment cost.

Formula 1

$$\text{Total Individual Investment for 2008} = R_c + [M_c * (PI_{08} / PI_{04})]$$

Elements of the Total Individual Investment equation are as follows:

- R_c: Recruiting cost for 2008
- M_c: MOS cost for 2004
- PI_{08}: Consumer Price Index for 2008 (215.3)
- PI_{04}: Consumer Price Index for 2004 (188.9)

D. FATALITY AND HOSPITALIZATION COST ESTIMATION

This section presents the data and methodology used to estimate the cost associated with fatality and hospitalization as a result of a motorcycle accident.

1. The Data

The author utilizes the accident data from the Naval Safety Center, coupled with life insurance information from the Department of Veterans' Affairs, and hospitalization costs from prior motorcycle accident studies to calculate the equivalent monetary cost for

motorcycle injuries and fatalities in fiscal year 2008 for the Navy and Marine Corps. The hospitalization costs in the motorcycle accident studies are based on an average ten-day hospital stay.

2. Fatality and Hospitalization Cost Methodology

In estimating the costs associated with motorcycle fatalities, the author first assumes the maximum life insurance payment for each Sailor or Marine killed in a motorcycle accident. In estimating hospitalization costs associated with motorcycle injuries, the author utilizes an average cost based on prior motorcycle crash studies conducted in 1989 by the state of Washington. The hospitalization cost figures are converted from 1989 constant dollars to 2008 constant dollars utilizing the Consumer Price Index (CPI) equation. Formula 2 shows the equation used in determining the total monetary cost associated with motorcycle fatalities and injuries.

Formula 2

$$\text{Total Fatality \& Injury Cost} = (F_{08} * LI_{max}) + (J_{08} * H_{08}) + (T_{08} * C_{08})$$

Elements of the Total Fatality & Injury Cost equation are as follows:

- F_{08}: Number of fatalities in 2008
- LI_{max}: Life insurance maximum payment
- J_{08}: Number of injuries in 2008
- H_{08}: Average motorcycle injury hospitalization cost in 2008, derived from the average cost in 1989. [H_{08} = avg. cost 1989 * (PI_{08} / PI_{89})]
- PI_{08}: Consumer Price Index for 2008 (215.3)
- PI_{04}: Consumer Price Index for 1989 (124.0)
- T_{08}: Number of traumatic injuries in 2008
- C_{08}: TSGLI cost of traumatic injuries

E. OTHER DATA

Additionally, a great amount of information was obtained through interviews with motorcycle industry officials, rider safety school owners and instructors, and several former world champion racers. This information is utilized to compare the value of a traditional MSF safety course versus a non-traditional track oriented motorcycle course.

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IV. DATA ANALYSIS

A. OVERVIEW

The previous chapter described the data and methodology used to perform analysis related to how motorcycle accidents affect the Navy and Marine Corps in terms of manpower and financial cost. The purpose of this chapter is to present the analysis and the results that will lead to a better understanding of how motorcycle accidents affect manpower readiness. Additionally, this chapter analyzes the cost and the benefits associated with maintaining the current motorcycle safety courses versus introducing a non-traditional motorcycle safety course. In the first section, motorcycle accident data is analyzed to determine the probability of a Sailor or Marine being involved in a motorcycle accident that will result in injuries, fatal or otherwise, that prevent him from performing his job. The second section examines the costs associated with recruiting and training Sailors and Marines, and the equivalent hospital costs associated with a Sailor or Marine injured in a motorcycle accident. The final section compares the cost of traditional motorcycle safety courses that Sailors and Marines are directed to attend to the cost of some of the non-traditional motorcycle safety courses that are available nationwide.

B. BACKGROUND

The Navy and Marine Corps dedicate much of their time, effort and money to training and retaining Marines and Sailors to have the manpower necessary to defend our nation and fight our nation's wars. The rising cost of manpower combined with the rising trend in motorcycle accidents and fatalities places both the Navy and the Marine Corps in a losing situation.

The Naval Safety Center reports that just over 3,900 separate units throughout the Department of the Navy combine for an approximate total of 48,158 military riders. Table 4 shows the breakdown of riders for the Navy and Marine Corps.

Table 4. Department of the Navy Motorcycle Rider Summary (After the Naval Safety Center, 2008)

Marine Corps Motorcycle Riders Summary		
Description	**Total**	**Percent (%)**
Marine Sport Bike Riders Reported	9856	55.3
Marine Standard Bike Riders Reported	7965	44.7
Total Marine Riders Reported	17821	100
**751 Marine UICs Reported*		
Navy Motorcycle Riders Summary		
Description	**Total**	**Percent (%)**
Navy Sport Bike Riders Reported	11767	37.8
Navy Standard Bike Riders Reported	18570	61.2
Total Navy Riders Reported	30337	100
**3179 Navy UICs Reported*		
Department of the Navy Summary		
Description	**Total**	**Percent (%)**
Total Sport Bike Riders	21623	44.9
Total Standard Bike Riders	26535	55.1
Total Dept. of the Navy Riders	48158	100
**3930 Total UICs Reported*		
From the Naval Safety Center		

Table 4 also shows a disproportionate percentage of sport bike riders in the Marine Corps when compared to sport bike riders in the Navy. This disproportion could be due to the recruiting and retention practices of each service. The Marine Corps is the younger branch of service in terms of personnel recruited because of more stringent age requirements and because of the Marine Corps' mission.

Only a very small percentage of the total number of registered riders in the Navy and Marine Corps are involved in motorcycle accidents annually. In fiscal year 2008, the Marine Corps had a total of 172 reported motorcycle accidents, while the Navy reported a total of 260 motorcycle accidents. Reported accidents include any documented accident involving a motorcycle regardless of the final outcome. Separately, these two figures account for approximately 1 percent of the total number of riders in each service. For fiscal year 2008, sport bike rider fatalities accounted for a disproportionately high

87 percent of all reported motorcycle fatalities in the Navy and Marine Corps. In comparison to the total number of motorcycle riders in the Department of the Navy, this extremely small percentage of riders are gaining the most attention, and may be the services' most expensive liability. The Navy and Marine Corps are not only losing Sailors and Marines to motorcycle accidents, but are also losing valuable manpower, money, and social credibility in the entire process.

Motorcycle riders in the Navy and Marine Corps cover a wide demographic range. The data from the Naval Safety Center provide demographic information including rider age, rank, and rider experience. The data also provide information on date and time of accident, location of accident, motorcycle type, rider injury classification, and whether or not there were lost work days associated with the accident.

C. PRELIMINARY PROBABILITY ESTIMATES

In this section of the analysis, the author focuses on finding the probability that a motorcycle rider who gets into an accident will have an injury (fatal or otherwise) that prohibits him from performing his job for any particular period of time. This analysis utilizes a probit model to determine the probability that an accident will be incapacitating. The variables and a description of each variable are listed in Table 3, in Chapter III.

The preliminary probit models for motorcycle fatality and injury requiring time away from work are as follows:

$$P(\text{Fatality} \mid x) = G(\beta 0 + \beta 1(\text{sport\_bike}) + \beta 2(\text{trng\_cmpltd}) + \beta 3(\text{spring}) + \beta 4(\text{summer}) + \beta 5(\text{south}) + \beta 6(\text{west}) + \beta 7(\text{jr\_enlsd}) + \beta 8(\text{staff\_enlsd}) + \beta 9(\text{age}))$$

$$P(\text{Miss Work} \mid x) = G(\beta 0 + \beta 1(\text{sport\_bike}) + \beta 2(\text{trng\_cmpltd}) + \beta 3(\text{spring}) + \beta 4(\text{summer}) + \beta 5(\text{south}) + \beta 6(\text{west}) + \beta 7(\text{jr\_enlsd}) + \beta 8(\text{staff\_enlsd}) + \beta 9(\text{age}))$$

Where all variables are defined in Table 3.

D. EMPIRICAL RESULTS

1. The Preliminary Probit Model

The results from the preliminary probit model indicate that the current motorcycle safety training does not significantly decrease a Sailor's or Marine's chance of being killed, given that he or she is involved in a motorcycle accident, but actually shows a slight increase of approximately 2.8 percentage points. Sailors and Marines who ride sport bikes, rather than other motorcycles, increase their chances of a fatal accident by approximately 5.8 percentage points. The overall results from the preliminary probit regression model indicate that a Sailor or Marine who has completed an approved motorcycle safety course still has a 10.1 percent probability of being killed if he or she is involved in a motorcycle accident. Table 5 presents the results for the *Fatality* preliminary regression.

Table 5. Preliminary Probit Model for Fatality

Fatality	Partial Effect	Std. Err.	z
Sport Bike	0.0582222	0.0167957	3.07*
Training Complete	0.0285943	0.0157753	1.78
Spring	-0.0057535	0.0195361	-0.29
Summer	0.0233045	0.019469	1.24
South	-0.0505337	0.0249168	-2.02*
West	-0.0477358	0.0241825	-1.92
Jr. Enlisted	-0.0050888	0.0381991	-0.13
Sr. Enlisted	0.0010761	0.0376635	0.03
Age	-0.0009198	0.0018177	-0.51
obs. P .1067568		Number of obs	1480
pred. P .1014732 (at x-bar)		Pseudo R2	0.0221
*Significant at 1%			

The results of the preliminary probit regression model for the *Miss Work* variable indicate that a Sailor or Marine who has completed approved motorcycle training and who is involved in an accident reduces his or her chance of being injured by approximately 10 percentage points. In this preliminary model, the fact of whether the

rider was operating a sport bike is negligible. However, considering all the variables together, the preliminary model indicates that a Sailor or Marine who is involved in a motorcycle accident has an overall 87.8 percent chance of being absent from work due to injuries sustained in that accident. Table 6 presents the results for the *Miss Work* preliminary regression.

Table 6. Preliminary Probit Model for Miss Work

Miss Work	Partial Effect	Std. Err.	z
Sport Bike	0.0021441	0.0207349	0.1
Training Complete	-0.1001976	0.0165848	-5.7*
Spring	-0.0386854	0.0222692	-1.82
Summer	0.0323075	0.0194146	1.59
South	-0.0996443	0.0369375	-2.71*
West	-0.0810379	0.0397474	-2.11*
Jr. Enlisted	0.0021863	0.0404314	0.05
Sr. Enlisted	0.022791	0.0370119	0.59
Age	0.0039263	0.0019886	1.97*
obs. P .8648649		Number of obs	1480
pred. P .8787612 (at x-bar)		Pseudo R2	0.0552
*Significant at 1%			

The author suspected that the *Rank* variables (junior enlisted, senior enlisted) and the *Age* variable may be correlated, affecting each other during regression calculations. The probit models were adjusted first by excluding the *Age* variable in one regression, and excluding the *Rank* variables in a second regression. The intent of the separate regressions is to see the effect the *Rank* and the *Age* variables had on each other, and on the overall *Fatality* and *Miss Work* probabilities.

2. Probit Regressions Including *Rank* Variables

The results of the probit regression including the *Rank* variables, and excluding *Age* show that the most significant variable with regard to motorcycle fatality is the *Sport Bike* variable, where a Sailor or Marine who is involved in a motorcycle accident has a 5.8 percentage point higher chance of being killed in the accident if he or she operates a sport bike. The *Training Complete* variable is marginally significant and shows an

increased 2.6 percentage points chance of motorcycle fatality for a Sailor or Marine who has completed an approved motorcycle course and is involved in a motorcycle accident. Both *Rank* variables are statistically insignificant with regard to motorcycle fatality. Considering all the variables in this regression, the overall probability of a Sailor or Marine being killed if he or she is involved in a motorcycle accident remains unchanged at 10.1percent. Table 7 shows the results of the probit regression for *Fatality* (excluding *Age*).

Table 7. Probit Model Results for Fatality (Excluding Age)

Fatality	Partial Effect	Std. Err.	z
Sport Bike	0.0586761	0.0163026	3.18*
Training Complete	0.0261182	0.0156946	1.64
Summer	0.0276157	0.0179603	1.59
West	-0.0086271	0.0158495	-0.54
Jr. Enlisted	0.0057284	0.0342116	0.17
Sr. Enlisted	0.0078066	0.0381996	0.21
obs. P .1058981		Number of obs	1492
pred. P .1016707 (at x-bar)		Pseudo R2	0.0175
*Significant at 1%			

The results of the probit regression including the *Rank* variables, and excluding *Age*, show that the most significant variable with regard to missing work as a result of a motorcycle accident is the *Training Complete* variable. In this case, a Sailor or Marine who has completed approved motorcycle training and is involved in a motorcycle accident has a 10.3 percentage point lower chance of being injured.

The *Summer* variable in this probit regression is statistically significant, and indicates an increased chance of 4.5 percentage points of a Sailor or Marine being injured if he or she is involved in a motorcycle accident. The *Rank* variables again play no significant role with regard to a Sailor or Marine missing work due to a motorcycle accident.

Considering all the variables, a Sailor or Marine involved in a motorcycle accident has an overall 87.6 percent probability of missing work due to injuries sustained in the accident. Table 8 shows the results of the probit regression for the *Miss Work* variable (excluding *Age*).

Table 8. Probit Model Results for Miss Work (Excluding Age)

Miss Work	Partial Effect	Std. Err.	z
Sport Bike	-0.0042019	0.0201445	-0.21
Training Complete	-0.1026406	0.0165762	-5.82*
Summer	0.0454398	0.0174244	2.45*
West	0.0105548	0.0172279	0.61
Jr. Enlisted	-0.0332744	0.0338644	-0.94
Sr. Enlisted	0.0287518	0.036397	0.75
obs. P .8659517		Number of obs	1492
pred. P .876118 (at x-bar)		Pseudo R2	0.0412
*Significant at 1%			

3. Probit Regression Including the *Age* Variable

The results of the probit regression including the *Age* variable, and excluding *Rank* variables, show that the most significant variable with regard to motorcycle fatality is the *Sport Bike* variable, where a Sailor or Marine who is in an accident has an increased probability of 5.8 percentage points of being killed if he or she operates a sport bike rather than other motorcycles. The *Training Complete* variable remains marginally significant and shows a 2.9 percentage points increased probability of being killed for Sailors or Marines who have completed an approved motorcycle course and are involved in a motorcycle accident. Both *Rank* variables remain statistically insignificant with regard to a Sailor or Marine missing work due to an injury accident. The *Age* variable is statistically insignificant with regard to motorcycle fatality. Considering all the variables in this probit regression, the overall probability of a Sailor or Marine being killed if he or she is involved in a motorcycle accident still remains relatively unchanged at 10.5 percent. Table 9 shows the results of the probit regression for *Fatality* (excluding *Rank*).

Table 9. Probit Model Results for Fatality (Excluding Rank)

Fatality	Partial Effect	Std. Err.	z
Sport Bike	0.0583641	0.0164289	3.15*
Training Complete	0.0296266	0.01541	1.89
Summer	0.019188	0.0174616	1.13
West	-0.0086139	0.0156491	-0.55
Age	0.000289	0.0013203	0.22
obs. P .1088608		Number of obs	1580
pred. P .1050916 (at x-bar)		Pseudo R2	0.0155
*Significant at 1%			

The results of the probit regression that includes the *Age* variable, and excludes the *Rank* variables, show that the most significant variable with regard to missing work as a result of a motorcycle accident is the *Training Complete* variable. In this case, a Sailor or Marine who has completed motorcycle training and is involved in an accident decreases his or her probability of being injured by approximately 8.9 percentage points.

The *Summer* variable in this probit regression is statistically significant, and indicates an increased probability of 4.1 percentage points of a Sailor or Marine being injured if involved in a motorcycle accident. In this probit regression the *Age* variable is statistically significant and indicates a minute 0.56 percentage point increased probability of a Sailor or Marine missing work due to a motorcycle accident.

As in the preliminary probit regression model, and the regression model that included the *Rank* variables, this probit regression indicates that a Sailor or Marine involved in a motorcycle accident has an overall 87.5 percent probability of missing work due to injuries sustained in a motocycle accident. Table 10 shows the results of the probit regression for the *Miss Work* variable (excluding *Rank*).

Table 10. Probit Model Results for Miss Work (Excluding Rank)

Miss Work	Partial Effect	Std. Err.	z
Sport Bike	0.0137461	0.0207118	0.68
Training Complete	-0.088603	0.0162673	-5.19*
Summer	0.0405805	0.0171181	2.25*
West	0.0173919	0.0167353	1.03
Age	0.0056163	0.0014673	3.79*
obs. P .8658228		Number of obs	1580
pred. P .8750279 (at x-bar)		Pseudo R2	0.0373
*Significant at 1%			

4. Probit Regression Summary

The results of the probit regression models indicate that the type of motorcycle ridden, completion of an approved motorcycle safety course, season (time of year), location, and age are just some of the variables that may play a part in determining the probability that Sailors or Marines, if involved in motorcycle accidents, suffer an injury or fatality.

There are very few variables that the Navy or Marine Corps can control in this regard, with the most influential variable being the type of approved motorcycle training Sailors and Marines are offered. The regression results indicate a 2.0 percentage points increased probability of fatality and only a 10.0 percentage points reduced probability of injury if a Sailor or Marine who has completed an approved motorcycle safety course is involved in a motorcycle accident. However, it is important to note that because we have no data on how the probability of an accident varies with training, the effects of the current motorcycle safety training on the probability of having a motorcycle accident cannot be deduced.

Although TEAM OREGON claims that the MSF's BRC may not be an appropriate course for novice riders, the data and the results of the probit regressions are unable to provide a distinct conclusion to support that claim. More research in

this area is necessary to determine the true effects motorcycle training has on the probability of being involved in a motorcycle accident.

E. ACCIDENT DATA BREAKDOWN

Since fiscal years 2000 through 2008, Navy and Marine Corps data indicate that a large portion of those Sailors or Marines involved in motorcycle accidents had injuries that kept them out of work for various periods of time (lost time, disabilities and fatalities are included in this figure and account for hours of manpower). Table 11 shows the results of reported motorcycle accidents for the Navy and Marine Corps from fiscal year 2000 through fiscal year 2008.

Table 11. Department of the Navy Motorcycle Accident Outcome

Navy Motorcycle Accident Results FY00 - FY08		
Accident Result	**Frequency**	**Percent (%)**
Fatal Injury	209	12.38
Lost Time Injury	1,321	78.26
Disabling Injury	58	3.44
Full Duty	100	5.93
Marine Motorcycle Accident Results FY00 - FY08		
Accident Result	**Frequency**	**Percent (%)**
Fatal Injury	126	13.29
Lost Time Injury	544	57.38
Disabling Injury	28	2.95
Full Duty	250	26.37

The data also indicate that the majority of the Sailors and Marines involved in motorcycle accidents are in the 18- to 23-year-old age group, predominantly first term service members. Sailors and Marine in the 18- to 23-year-old age group age group are followed closely by service members in the 24- to 29-year-old age group. These two age groups alone are a mixture of first term and career service members. Combined they make up just over 82 percent of all motorcycle accidents reported between fiscal year

2000 and fiscal year 2008. Figure 2 shows motorcycle accidents by age group for the Department of the Navy between fiscal years 2000 through 2008.

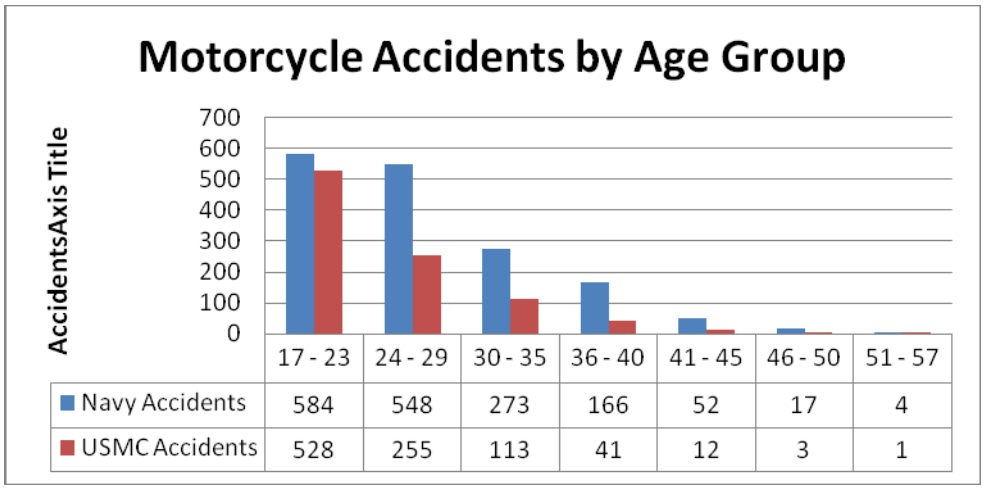

Figure 2. Navy and Marine Corps Motorcycle Accidents by Age Group

Sailors and Marines in these two age groups are of particular interest because they comprise mostly those service members who have completed military occupational specialty (MOS) training and are completing their first fleet assignment, or Sailors and Marines who reenlisted, and may have taken a reenlistment bonus. These are service members that the Navy and Marine Corps have invested in through training and financial compensation, but will be unable to use to their full potential, owing to the fact that they will have to be out of work for various periods of time due to a multitude of injuries received as a result of being involved in motorcycle accidents.

F. DEPARTMENT OF THE NAVY COST ESTIMATES

The Navy and Marine Corps both have requirements for various technical and non-technical MOSs. Depending on a Sailor's or Marine's occupational specialty, training length can vary from 4 weeks to 24 months. Traditionally, the training for technical MOSs is much longer than for non-technical MOSs, and in most cases much more costly to the services than training for non-technical MOSs. The Navy and Marine Corps invest in their Sailors and Marines with the assumption that Sailors and Marines will be present to perform their jobs to the best of their abilities throughout the length of their service obligations.

1. Individual Recruiting and Training Costs

In determining how much it costs the services to recruit and train someone, individual costs must be tracked from the moment that person expresses interest in the Navy or Marine Corps, through to the completion of his or her primary MOS (PMOS) schools. The total investment per individual includes all monetized costs recognized by the services.

As of fiscal year 2008, Marine Corps Recruiting Command estimates that the Marine Corps spends $10,246 on each individual recruited for service in the Marine Corps (Marine Corps Recruiting Command, personal communication, March 23, 2009). The Navy's 2008 recruiting cost estimate is approximately $13,500 for an individual enlisting in the Navy (without a recruiting bonus). These estimates cover the cost of the period from when an individual first expresses interest in the Navy or Marine Corps, until that individual is standing on the yellow footprints at the Marine Corps Recruiting Depot or the Navy's Recruit Training Command (RTC) (Sumrall & Gualandi, 2008).

Unfortunately, neither the Navy nor Marine Corps collects compiled cost information for individual PMOSs. For this thesis, the author uses an earlier study, conducted in 2004 by the Center for Naval Analysis (CNA) for cost estimate calculations for each PMOS. These cost estimates include the costs for basic training, personnel cost, and MOS schoolhouse cost. The CNA study determines the cost estimates as follows.

> The 2002 Critical Indicators Study developed a methodology for calculating the average time it takes to become occupationally qualified and provided time-to-train days for each PMOS. Past research indicated that training costs were directly related to training time: training costs could be approximated by multiplying the number of days in training by daily base pay for the trainee and by a scale factor. Thus, we monetize the number of training days for training costs.
>
> The "time to train" is the time between the beginning of bootcamp (yellow footprints)[1] and assignment to a primary PMOS. It includes time spent in training, as well as time spent waiting for training to begin, transit time, and so on. These calculations were for new recruits and included 122 days that lateral

[1] The yellow footprints are silhouettes of shoes painted on the ground in yellow paint. Traditionally, they are organized as though in military formation and are located in a recruit staging area. The yellow footprints signify the beginning of a recruit's journey to becoming a Marine.

> movers would not be required to complete (MCRD, boot leave, and Marine combat training (MCT)) (Center for Naval Analysis, p. 80).

For the purpose of analysis, six cost estimates were selected for six separate Marine Corps PMOSs ranging from lower to higher cost of training. The PMOSs were selected to show diversity in MOS selection, and to have a wide range of cost estimates of various PMOSs for analysis.

Since the PMOS cost estimates in the previous CNA study only focused on Marine Corps occupational specialties, six specialties also were selected from the Marine PMOS list to represent occupational specialties that are equivalent to the Navy's occupational ratings (jobs). The analysis assumes that since the Navy and Marine Corps frequently combine to attend the same service schools for numerous military occupational specialties, then the "time to train" is similar for both Marines and Sailors in similar occupational specialties. Hence, the cost of training an enlisted Marine for a particular occupational specialty is similar to the cost of training an enlisted Sailor in that same occupational rating. Tables 12 and 13 show Navy and Marine Corps occupational specialties, their equivalent training days, training cost estimate for calendar year 2004, and an updated estimated training cost estimate for calendar year 2008. Using the Consumer Price Index (CPI), Formula 3 shows the equation used to convert 2004 constant dollars to 2008 constant dollars and calculate the total individual investment.

Formula 3.

$$\text{Total Individual Investment for 2008} = R_c + [M_c * (PI_{08} / PI_{04})]$$

- R_c: Recruiting cost for 2008
- M_c: MOS cost for 2004
- PI_{08}: Consumer Price Index for 2008 (215.3)
- PI_{04}: Consumer Price Index for 2004 (188.9)

Table 12. Navy Individual Investment Cost Estimate (After the Center for Naval Analysis, 2004, pp. 109–122)

Navy Occupational Rating Training Cost Estimates				
Occupation Title	**Training Days**	**Training Cost per Graduate in 2004 $**	**Training Cost per Graduate in 2008 $**	**Total Individual Cost**
Fixed Wing Aircraft Power Plants J-52	100	$17,813	$20,303	$33,803
Aviation Ordnance System Technician	176	$30,400	$34,649	$48,149
Aircraft Electrical System Technician F/A-18	293	$53,874	$61,404	$74,904
Aircraft Electrical/Instrument/ Flight Control	365	$68,967	$78,607	$92,107
Air Traffic Controller	426	$97,128	$110,704	$124,204
Russian Cryptologist	614	$123,522	$140,787	$154,287

Table 13. Marine Corps Individual Investment Cost Estimate (After the Center for Naval Analysis, 2004, pp. 109–122)

Marine Corps MOS Training Cost Estimates				
Occupation Title	**Training Days**	**Training Cost per Graduate in 2004 $**	**Training Cost per Graduate in 2008 $**	**Total Individual Cost**
Basic Rifleman	72	$12,960	$14,771	$25,017
M1 A1 Tank Crewman	114	$20,266	$23,099	$33,345
Aircraft Maintenance GSE	277	$48,832	$55,657	$65,903
Reconnaissance Man	322	$68,826	$78,446	$88,692
Helicopter Crew Chief	288	$82,080	$93,553	$103,799
Arabic Cryptologist	712	$143,238	$163,259	$173,505

2. Motorcycle Accident Cost

The Navy and Marine Corps invest millions of dollars in training Sailors and Marines for their various military occupational specialties. Sailors and Marines are expected to perform their jobs to the best of their abilities, once they have completed their training, for the duration of their military contracts. If a Sailor or Marine is injured in a motorcycle accident prior to the completion of his or her military contract, that Sailor or Marine may not be able to perform his or her job for any particular amount of time (usually the time it takes for them to recover). In the worst-case scenario, due to the severity of the injuries, the Sailor or Marine may be unable to complete his or her military contract. Fatalities and disabilities create a shortage of manpower, and necessitate recruiting and training replacement personnel. Recruiting and training replacement personnel creates an additional expense for both services.

Over the past several years, the military in general has focused on the number of annual motorcycle fatalities. Motorcycle fatalities usually command much attention because of the catastrophic nature of those events. However, fatalities are just one portion of the overall problem. The data from the Naval Safety Center indicate that fewer than 20 percent of motorcycle accidents reported annually resulted in rider fatalities, while a very large percentage of motorcycle accidents involving Sailors and Marines resulted in incapacitating injuries. Between fiscal years 1999 and 2008, the Navy had over 1600 reported motorcycle accidents. Between fiscal years 2000 and 2008, the Marine Corps reported over 970 motorcycle accidents. The Naval Safety Center data indicate that the Navy and Marine Corps reported a total of 311 motorcycle fatalities, and 2,286 motorcycle injuries resulting in lost work time, between fiscal years 2000 through 2008.

a. Life Insurance Costs

While neither the Navy nor Marine Corps tracks the costs associated with motorcycle accidents, a cost analysis was examined using data from the Naval Safety Center, Servicemembers' Group Life Insurance (SGLI), information from the Department of Veterans Affairs, and hospitalization costs information from various

motorcycle injury cost studies. Cost analysis was utilized to determine the monetary equivalent of the amount of funds the Department of Defense would have paid as a result of fatalities and injuries due to motorcycle accidents in the Navy and Marine Corps. For the purpose of this analysis, observations from fiscal year 2008 were utilized as being the most recent and complete. Table 14 shows the classification of motorcycle accident injuries, frequencies and percentages for the Navy and Marine Corps in fiscal year 2008.

Table 14. Motorcycle Accident Outcome for Fiscal Year 2008

Marine FY 2008 Injury Summary			
Injury	**Freq.**	**Percent**	**Cum.**
Fatal Injury	25	15.24	15.24
First Aid Injury	4	2.44	17.68
Lost Time Injury	96	58.54	76.22
No Injury	37	22.56	98.78
Permanent Total Disability	0	0	0
Permanent Partial Disability	2	1.22	100
Total	164	100	
Navy FY 2008 Injury Summary			
Injury	**Freq.**	**Percent**	**Cum.**
Fatal Injury	33	12.74	12.74
First Aid Injury	10	3.86	16.6
Lost Time Injury	206	79.54	96.14
No Injury	3	1.16	97.3
Permanent Total Disability	0	0	0
Permanent Partial Disability	7	2.7	100
Total	259	100	

The Department of Veterans Affairs describes Servicemembers' Group Life Insurance (SGLI) as follows:

> SGLI is a program of low cost group life insurance for service members on active duty, ready reservists, members of the National Guard, members of the Commissioned Corps of the National Oceanic and Atmospheric Administration and the Public Health Service, cadets and midshipmen of the four service academies, and members of the Reserve Officer Training Corps.

> SGLI coverage is available in $50,000 increments up to the maximum of $400,000.
>
> SGLI provides group term life insurance. When you die, money will be paid to the person (persons) you designate to receive the insurance. The beneficiary can use this money to pay expenses related to your death or invest the money to help replace your salary. Since SGLI is term insurance, it does not have cash or loan values and it does not pay dividends. (United States Department of Veterans Affairs, n.d.)

SGLI will have to pay up to $400,000 in the event a Sailor or Marine is killed in a motorcycle accident. Along with SGLI benefits, Sailors and Marines involved in an accident may qualify for payments through the Traumatic Injury Protection Under Servicemembers' Group Life Insurance (TSGLI) program. The Department of Veterans Affairs describes TSGLI as follows:

> The Traumatic Injury Protection Under Servicemembers' Group Life Insurance (TSGLI) program is a rider to Servicemember's Group Life Insurance (SGLI). The TSGLI rider provides for payment to service members who are severely injured (on or off duty) as the result of a traumatic event and suffer a loss that qualifies for payment under TSGLI.
>
> TSGLI payments are designed to help traumatically injured service members and their families with financial burdens associated with recovering from a severe injury. TSGLI payments range from $25,000 to $100,000 based on the qualifying loss suffered.
>
> TSGLI coverage will pay a benefit of between $25,000 and $100,000 depending on the loss directly resulting from the traumatic injury
>
> Every member who has SGLI also has TSGLI effective December 1, 2005.
>
> TSGLI coverage is automatic for those insured under basic SGLI and cannot be declined. The only way to decline TSGLI is to decline basic SGLI coverage. (United States Department of Veterans Affairs, n.d.)

TSGLI provides the opportunity for a Sailor or Marine who sustains a traumatic injury or loss due to a motorcycle accident to place a claim that qualifies him or her for payments up to $100,000, depending on the injury.

The following assumptions are made in estimating the monetary cost of fatalities and injuries sustained in a motorcycle accident for Sailors and Marines.

- Each service member opted to select the maximum SGLI coverage of $400,000.
- Each service member involved in a fatal accident died at the scene.
- Each service member covered under SGLI is automatically covered under TSGLI for up to $100,000.
- TSGLI was paid in fiscal year 2008 due to permanent partial disability injuries sustained by Sailors and Marines.
- Since the nature of the partial disability injuries sustained by service members is unknown, assume that a $50,000 payment was paid on behalf of the injured Sailor or Marine.

In terms of permanent total or permanent partial disability injuries, a service member who must be removed from service because of a disability, in most cases, will be compensated with a percentage of his or her military pay for the rest of his or her life. While these compensations could add up to significant costs to the Department of Defense over the long run, studying this long run compensation cost is beyond the scope of this thesis.

b. Hospitalization Costs

The next portion of the analysis is to determine the hospitalization cost for injuries sustained due to motorcycle accidents. For the purpose of this analysis, only injuries that require hospitalization are considered. Fatal injury accidents are excluded from the hospitalization cost analysis due to lack of information on whether the motorcycle operator was killed at the scene of the accident or died later in the hospital. First-aid injury accidents and no injury accidents are excluded from the hospitalization cost analysis since the financial responsibility to the military is negligible.

A study conducted by Rowland et al. (1996), based on motorcycle accident injuries in the state of Washington for the year 1989, estimates that the average cost of hospitalization for riders involved in a motorcycle accident was $12,689 (± $1302) per person if the riders were wearing helmets. The same study estimates that

hospitalization costs for riders who were not wearing helmets at the time of the accident were $16,460 (± $1971) per person. The estimates in this study are in 1989 dollars (Rowland et al., 1996, p. 43). The data from the Naval Safety Center differentiates between riders with and without helmets at the time of accident. However, because of missing data, riders without helmets at the time of the accidents could not be determined. Therefore, only the cost estimate for riders wearing helmets was utilized in the hospital cost analysis. The average cost of hospitalization for riders in 2008 was estimated at $22,032.

c. Total Cost of Motorcycle Accidents

In order to estimate the equivalent cost for motorcycle accidents reported in the Navy and Marine Corps for fiscal year 2008, Formula 2 is applied.

> Motorcycle Accident Cost Estimate FY 2008 = (No. of fatalities * $400,000) + (No. of injury accidents * $22,032) + (No. of traumatic injuries *$50,000)

Table 15 illustrates the total motorcycle accident cost estimates calculation for fiscal year 2008.

Table 15. Fiscal Year 2008 Motorcycle Injury Cost Estimates

Marine FY 2008 Injury Cost Estimate			
Injury	**Freq.**	**Cost**	**Total**
Fatal Injury	25	$400,000	$10,000,000
Lost Time Injury	98	$22,032	$2,159,136
Permanent Total Disability	0	0	0
Permanent Partial Disability *	2	$50,000	$100,000
Total	164		$12,259,136
Navy FY 2008 Injury Cost Estimate			
Injury	**Freq.**	**Cost**	**Total**
Fatal Injury	33	$400,000	$13,200,000
Lost Time Injury	213	$22,032	$4,692,816
Permanent Total Disability	0	0	0
Permanent Partial Disability *	7	$50,000	$350,000
Total	259		$18,242,816

*Disability is also included in Lost Time Injury category

The estimates in Table 15 do not include the cost of training the individual Sailor or Marine for his or her primary military occupational specialty (PMOS). The data from the Naval Safety Center does not specify the MOSs of the Sailors or Marines in the dataset. In order to provide a snapshot of motorcycle accident cost combined with the cost of individual training, three Navy MOSs, and three Marine Corps MOSs, were selected for comparison analysis. The six MOSs represent a range from relatively low training cost to high training cost, and were matched with probable outcomes of motorcycle accidents. Table 16 illustrates the comparison analysis for selected MOSs.

Table 16. Navy and Marine Corps Individual Accident Cost Comparison

Navy Accident Outcome Cost Comparison				
Occupation Title	**Accident Outcome**	**Training Cost**	**Accident Cost**	**Total**
Fixed Wing Aircraft Power Plants J-52	Fatality	$ 33,803	$ 400,000	$ 433,803
	Injury & Disability	$ 33,803	$ 22,032 + $ 50,000	$ 105,835
	Injury	$ 33,803	$ 22,032	$ 55,835
Aircraft Electrical System Technician F/A-18	Fatality	$ 74,904	$ 400,000	$ 474,904
	Injury & Disability	$ 74,904	$ 22,032 + $ 50,000	$ 146,936
	Injury	$ 74,904	$ 22,032	$ 96,936
Russian Cryptologist	Fatality	$ 154,287	$ 400,000	$ 554,287
	Injury & Disability	$ 154,287	$ 22,032 + $ 50,000	$ 226,319
	Injury	$ 154,287	$ 22,032	$ 176,319
Marine Corps Accident Outcome Cost Comparison				
Occupation Title	**Accident Outcome**	**Training Cost**	**Accident Cost**	**Total**
Basic Rifleman	Fatality	$ 25,017	$ 400,000	$ 425,017
	Injury & Disability	$ 25,017	$ 22,032 + $ 50,000	$ 97,049
	Injury	$ 25,017	$ 22,032	$ 47,049
Helicopter Crew Chief	Fatality	$ 103,799	$ 400,000	$ 503,799
	Injury & Disability	$ 103,799	$ 22,032 + $ 50,000	$ 175,831
	Injury	$ 103,799	$ 22,032	$ 125,831
Arabic Cryptologist	Fatality	$ 173,505	$ 400,000	$ 573,505
	Injury & Disability	$ 173,505	$ 22,032 + $ 50,000	$ 245,537
	Injury	$ 173,505	$ 22,032	$ 195,537

G. TRADITIONAL AND NON-TRADITIONAL SAFETY COURSES

For the purpose of this analysis, the term “traditional course” is used to describe the course of instruction provided by the MSF, and takes place on a MSF type riding range. The term “non-traditional course” is used to describe a course provided by another organization, and takes place at a racetrack. Most people know this non-traditional course as track day.

1. Traditional Motorcycle Safety Training

The traditional Motorcycle Safety Foundation (MSF) courses take students through a number of riding drills on a range course at speeds usually less than 40 miles per hour. The limited speed at which the MSF course is conducted is good for a rider who is learning to ride for the first time. It allows new riders to focus, and think about the actions required to maneuver the motorcycle as desired. The Military Sport Bike Rider Course (MSRC), also provided by the MSF, provides riding drills that are much more specific to sport bikes. The MSRC also is a great tool for building a solid foundation for sport bike riders. However, while all the MSF courses are necessary as first-line starter courses, they are somewhat limited when applied to motorcycles and the people who ride them. The first important issue that comes to mind is the lack of other traffic when completing an MSF course. On the riding range, where the students execute riding drills, each student performs the drills alone while other students wait their turn. It is extremely rare, however, that a motorcyclist finds himself on the road without having to share it with other motorists. Other motor vehicles can make an inexperienced rider both distracted and nervous, especially at highway speeds, which in turn can be a negative in terms of learning to ride properly or riding with confidence. The MSF courses do not prepare riders to deal with the different sensory cues that other motor vehicles provide on public streets and highways.

A second issue is the low speeds at which the MSF courses are conducted. While the MSF courses’ relatively low speeds are consistent in helping riders learn the basics of controlling a motorcycle, the moment the riders get on public streets and highways, where the typical speed limit is between 55 to 65 miles per hour, riders already have to

ride above their limits. Basically, not only are inexperienced riders being bombarded with sensory and visual cues from other traffic, but are riding faster than they have been trained to ride while trying to merge into traffic and maintain highway speeds. In this case, the low speeds at which the riding drills are executed are unrealistic when compared to the average speeds on the road, which leads into the next issue.

The most common single vehicle motorcycle accident is caused by riders' failure to negotiate a curve or losing control in a curve. Very often, improper initial actions on the part of the rider cause a chain reaction that leads to loss of control in a curve. Based on the study completed by TEAM OREGON, some instructors highlighted that students who completed the MSF's BRC lacked head and eye movement which is critical in cornering, and were less prepared for cornering (Axman Consulting Incorporated, 2004, p. 8). Inexperienced riders often have difficulty judging closure rate and corner entry speed, and looking through a corner as they negotiate it. The situation is further complicated when the rider is dealing with other traffic, and riding above his or her limits at speeds faster than those at which they have been trained.

2. Non-traditional Motorcycle Safety Training

In comparison to the traditional courses offered by the MSF, a non-traditional course, otherwise known as a "track day," will help riders deal with these issues in a controlled environment suited for motorcycles at minimum risk to the riders. Wikipedia describes a motorcycle track day as follows:

> A track day is an organized event in which members of the public are allowed to drive or ride around established motor racing circuits, or alternatively (though far less common) on closed or disused airfields. Most race tracks around the world now provide this facility, whereby any road legal or track prepared vehicle, (car or motorcycle) can be used without speed restriction (as if racing, though the practice of actual racing is almost exclusively forbidden at these events) by members of the public. Criteria for being eligible to participate are usually the holding of a driving license for the vehicle in question, and the payment of a fee.
>
> There are varying formats for the proceedings, but they usually consist of two or three groups loosely corresponding to an individual's level of experience and/or how quick they are, (e.g., Novice / Intermediate /

> Advanced or Beginner / Experienced). One group at a time will then take to the track in order that the majority on track at any given time is travelling at similar speed, and there is usually time for a varying number of these sessions throughout the event. Usually, participants use their own vehicles, however a growing number of tracks and organizers can provide hire vehicles if required, while quite often, extra facilities such as instructor guidance, tire sales and advice and even suspension sales and set-up are available.
>
> Track days are also often held in the guise of racing schools where the emphasis is on nurturing the finer skills of machine control and race craft, often under the tutelage of experienced former racers. Whatever the interpretation, primarily track days are all about having fun, whether motorbike or car, the emphasis is on enjoyment in a controlled and suitable environment.
>
> As the performance of vehicles (especially in relation to motorcycles) increases, the track day can prove an invaluable means of improving the skills necessary to properly control these machines at or nearing their full potential in relative safety. It is a common feedback from track day enthusiasts that it helps them define the massive distinction between road and track riding/driving styles and as a result, through improved skill levels and attitudes, can have a positive effect on their road safety.
>
> As riders and drivers become more secure with their abilities and the track environment they can progress to "Open-Pit Lane" events (more common with car track days rather than bike days). These events dispense with the groups format and participants have unlimited access to the circuit throughout the event. This is usually controlled by an organizer by populating the event with fewer participants, albeit usually at a higher price, with instructor guidance facilities usually available. (Track day, n.d.)

At an organized track day, riders are broken down into two or three groups, depending on their skill level, and each group takes to the track each hour for 20-minute sessions. The grouping is done to encourage riders to ride within their comfort level. In most cases, riders will spend 30 to 35 minutes in classroom sessions discussing various riding exercises/drills. After the classroom sessions, the riders spend their track session executing those drills discussed in the classroom under the watchful eyes of "control riders" or experienced track day instructors. Control riders and track day instructors usually come with plenty of street riding experience and some racing experience. After

each session, each rider is critiqued and receives feedback from his or her instructor, and occasionally instructors will pull riders in from riding sessions to make immediate corrections. Most organizations utilize the lead-follow format of training, where the instructor first leads student riders around the track demonstrating the exercises to be executed, then follows the student riders as they execute the drills. When the instructors are confident that a student rider can negotiate the track without being a hazard to themselves or other riders, the student is released to ride on their own, while still being monitored at a distance by on-track instructors. The purpose for doing this is to build the students' confidence in their own abilities, allow them to execute the drills on their own, and to monitor students' progress and behavior without their knowledge. This format works because, unlike a traditional safety course, the track course teaches to the students' skill levels.

The track sessions allow inexperienced riders to navigate the racetrack at speeds at or above the typical 55 to 65 mph speed limit found on streets and highways. Learning to control motorcycles at realistic speeds help riders judge closure rate, corner entry speed, and let them practice how to react quickly and correctly in case of emergencies.

Track sessions also help riders adjust to riding with other traffic as they pass and are passed by other riders, which provides valuable experience in terms of picking up on sensory cues without being distracted, and becoming more comfortable with riding in traffic.

Track day organizations place a great amount of emphasis on negotiating curves, otherwise known as cornering. Motorcycles go from point A to B in a straight line with very little effort, but where riders usually get into trouble is when cornering. Track day instructions focus on braking for an upcoming corner, corner entry speed, looking through the turn, and exiting the corner. Instructors teach riders to select a riding line, ride to the apex of a corner, and find and ride through an exit point. At the end of a full track day, student riders are consistently and simultaneously executing these tasks, and successfully negotiating one corner after another.

Track days also provide a few additional benefits for riders of all skill levels that traditional riding courses do not provide. First, most track day organizations are now utilizing digital video cameras on their instructor bikes that record students' performances throughout the course of the day. Instructors are able to pick up cues from a rider's body language or riding style that may indicate that he or she needs help or requires further instruction. The video recordings not only allow student riders to hear about their performance, but also have the added benefit of letting them see their performance as the instructors provide feedback and constructive criticism. There is usually a big difference between what the student thought he or she did versus what he or she actually did.

Second, because the racetrack is a controlled environment, mistakes that lead to crashes are much more forgiving than a mistake that leads to a crash on public streets or highways. Most of the riders who crash at a track day event walk away under their own power with as little as a bruised ego. A racetrack is designed to allow riders or drivers the leeway of making mistakes and recovering from those mistakes. Air fences, hay bales, run-off areas, and sand traps are just some of the safety features on a racetrack that help minimize injury to motorcycle riders attending a track day event. Additionally, all track day organizations are required to have corner workers placed in different areas of the track. The corner workers' main job is to communicate with the track organizers through radios, communicate with riders on the track through colored flags, identify unsafe riders or riders who are placed in an incorrect group, and stop the course of riding and clear the racetrack in the event of an emergency. The racetrack is the place to make mistakes as the odds of surviving and learning from a crash are extremely high.

Another benefit for inexperienced riders who attend track day events is that it allows the riders to get a better understanding of what can and cannot be done on a motorcycle on the street. It is not uncommon for riders who participate in track day events to limit their amount of street riding or stop riding on the street altogether. Lance Keigwin, owner and operator of the Keigwins at the Track organization, has been providing track day instructions since 1998, and he believes that participating in track day events not only helps riders to improve their street riding skills drastically, but also to

change riders' perspective in terms of riding on the street. In Keigwin's experience as a track day organizer, he has observed that the majority of riders who attend track day events either give up riding on the street, or become more conservative when riding on the street. Keigwin believes that "coming to the racetrack does not feed the need to go fast on the street, it tames it" (personal communication, September 11, 2009).

There are several tangible and intangible benefits that come from track day training for motorcycle riders. Track day events are especially beneficial to sport bike riders because it allows them to gain a wealth of experience in an extremely small amount of time (normally one full day of classroom and track instructions). Reg Pridmore, a three-time American Motorcycle Association (AMA) road racing champion, has been training motorcyclists since 1974. In his experience in training motorcyclists, the most common comment heard from students at the end of the training day is that they have learned more in one day of track instruction than they have in a year—or sometimes 20 years—of riding on the street (R. Pridmore, personal communication, March 19, 2009).

Three-time FIM 500cc Grand Prix World Champion Wayne Rainey believes that "Riding a motorcycle should be like putting on your pants." He also believes that the racetrack is the safest place to learn how to ride a motorcycle properly. He explains that, "Because the conditions on the racetrack never changes…a rider can get to ride safely, and be able to get feedback from other riders. All those things will help a street bike rider tremendously" (W. Rainey, personal communication, December 2, 2009). It is a fair assumption that the majority of the professional motorcycle road racing community shares the same opinion when it comes to motorcycles and the safest place to operate them. Although Rainey was paralyzed from an accident in a professional motorcycle race in 1993, he still believes his injury from that accident is very uncommon. Rainey describes his racetrack experience below.

> I raced motorcycles for 24 years. I will ride a bike for 15,000 miles each year. That's practice, that's testing, that's qualifying, and that's racing. So that's 15,000 miles at 95% of what the motorcycle's capability of doing. I think I fell down three times that year. Throughout my career, I've fallen off a bunch. If you are going to ride a motorcycle at the limit, it's not like a car where you can make a mistake and slide out or spin out, and put it back in gear. On a motorcycle you are going to separate

> yourself, but 99% of the times I got up and walked away. (W. Rainey, personal communication, December 2, 2009)

Keith Code of the California Superbike School has been training motorcyclist since the mid 1970s. Students who have completed riding courses with Code's organization often leave feedback about how much they have learned, and the level of confidence they achieved through the course of instruction. Code has been working with the Marine Corps since 2006 through the Advanced Motorcycle Operator School (AMOS), a program specifically designed with reducing service member motorcycle accidents in mind. Since the implementation of Code's AMOS course, a Second Marine Expeditionary Force (2d MEF) motorcycle statistic report for calendar year 2008 highlighted that with over 330 rider students trained in Code's AMOS course, there had been only three Class C mishaps, compared to the 164 accidents in fiscal year 2008 for non-AMOS riders (2d Marine Expeditionary Force, 2009). This may indicate that non-traditional training may be the most effective way of reducing motorcycle accidents in the Navy and Marine Corps

3. Cost Comparison: Traditional and Non-traditional Safety Training

Traditional and non-traditional motorcycle training costs vary depending on the location of the training. On average, the Motorcycle Safety Foundation's (MSF) Basic Rider Course (BRC) costs the military approximately $250 per rider for riders 21 years and older, and $150 for riders younger than 21 years of age. The Military Sport Bike Rider Course (MSRC) costs are similar to the BRC, while the Experienced Rider Course (ERC) costs approximately $150 per rider (J. Rice, personal communication, January 10, 2010). The BRC is mandatory for all Navy and Marine motorcycle riders regardless of the type of motorcycle each service member rides. The MSRC is mandatory for all Navy and Marine Corps personnel who ride sport bikes, while the ERC is not mandatory, but highly recommended for those service members who do not ride sport bikes.

On average, non-traditional motorcycle courses are priced from $150 to $350 depending on the location of the training. Traditionally, the most expensive courses are associated with the name of the track where the event is being held. For example, most riders

can complete a motorcycle course at Buttonwillow Raceway in Buttonwillow, California, or Willow Springs Raceway in Rosamond, California, for approximately $150 per rider, while completing a course at Laguna Seca in Monterey, California, or Infineon Raceway in Sonoma, California, may cost as much as $280 per rider. Most organizations that conduct non-traditional motorcycle training have schedules that take them to several different locations, over several months. The organizations' flexible schedules offer riders plenty of opportunities to choose a date and location that best fits the riders' schedules and budgets. Table 17 shows a partial schedule for the North Eastern Sport Bike Association (NESBA), which illustrates a typical track day organization's schedule and costs.

Table 17. Typical Track Day Schedule and Costs (From North Eastern Sport Bike Association, 2010)

February			
Date	**Track**	**Location**	**Price**
2/27/2010	Barber	Birmingham, AL	$205
2/28/2010	Barber	Birmingham, AL	$205
April			
Date	**Track**	**Location**	**Price**
4/2/2010	Road Atlanta	Braselton, GA	$195
4/3/2010	Road Atlanta	Braselton, GA	$205
4/4/2010	Road Atlanta	Braselton, GA	$195
4/24/2010	Barber	Birmingham, AL	$205
4/25/2010	Barber	Birmingham, AL	$205
May			
Date	**Track**	**Location**	**Price**
5/14/2010	VIR - North	Alton, VA	$185
5/15/2010	VIR - South	Alton, VA	$185
5/28/2010	Road Atlanta	Braselton, GA	$195
5/29/2010	Road Atlanta	Braselton, GA	$205
5/30/2010	Road Atlanta	Braselton, GA	$195
June			
Date	**Track**	**Location**	**Price**
6/12/2010	CMP	Kershaw, SC	$155
6/13/2010	CMP	Kershaw, SC	$155
July			
Date	**Track**	**Location**	**Price**
7/3/2010	VIR - South	Alton, VA	$165
7/4/2010	VIR - South	Alton, VA	$165
7/16/2010	VIR - Full Course	Alton, VA	$195
7/17/2010	VIR - Patriot	Alton, VA	$125

In order to compare the costs of a traditional MSF course to a non-traditional course, the following table is created with estimates for each type of course. A 2007 demographics report conducted by the Personnel and Family Readiness Division, Headquarters, Marine Corps, reported that 24 percent of all Marines were younger than age 21 (Marine Corps Community Services, 2007, p. 2). This demographic was applied to those who rode motorcycles in the Navy and Marine Corps in order to complete the estimate. An estimate for the Experienced Rider Course (ERC) was not included since the course is not mandatory. However, if all non-sport bike riders decide to complete the ERC at its current $150 cost, the overall estimate would come to approximately $4 million. Table 18 illustrates those cost estimates.

Table 18. Traditional and Non-traditional Motorcycle Course Cost Estimates

BRC Cost			
	All Riders	**Cost**	**Total**
Younger than 21	11558	$150	$ 1,733,688.00
Older than 21	36600	$250	$ 9,150,020.00
Total Cost			$ 10,883,708.00
MSRC Cost			
	Sport Bike Riders	**Cost**	**Total**
Younger than 21	5190	$150	$ 778,428.00
Older than 21	16433	$250	$ 4,108,370.00
Total Cost			$ 4,886,798.00
Non-traditional Course			
	All Riders	**Cost**	**Total**
Younger than 21	11558	$200	$ 2,311,584.00
Older than 21	36600	$200	$ 7,320,016.00
Total Cost			$ 9,631,600.00

Realistically, motorcycle safety training could not accommodate all motorcycle riders in the Navy and Marine Corps in a single year. Therefore, it is relatively fair to assume that the training could be spread over a period of 3 years to minimize the overall annual cost to the military. Essentially, it would cost a total of $9.6 million to provide non-traditional training to all motorcycle riders in the Department of the Navy. This would amount to approximately $3.2 million annually, with this amount divided between the Navy and Marine Corps based on the number of riders from each service. The costs of the traditional and non-traditional motorcycle courses are relatively equal. The

difference is in the value of the training that the riders receive. The MSF motorcycle safety courses may just be touching the surface when it comes to what it really takes to fully control a motorcycle on public streets or highways. A non-traditional motorcycle course builds on the skills that a rider has learned from a traditional motorcycle course. Typical non-traditional or track day riding courses serve several purposes. Track day riding courses:

- Provide realistic training at realistic speeds.
- Help riders understand their own capabilities and the capabilities of their motorcycles, and are tailored to fit various riding levels.
- Help riders understand how the components on their motorcycles work together when operating in the street environment.
- Reinforce a great amount of training and practice in a very short period of time.
- Provide continuous on-track practice sessions to maximize actual riding time.
- Quench riders' need for speed on the street by providing a legal outlet.
- Help riders understand the danger of riding fast on the street.
- Deter aggressive riding behavior on the street that may be hazardous to the riders and the general public.

Motorcycle riding is inherently risky. Riders who are unprepared to handle their motorcycles are at a much higher risk of being involved in an accident that may result in death or serious injury to themselves or others. Realistic training and practice significantly reduces that risk. Most track day organizers and track day school instructors agree that track day riders become much safer, more-experienced street riders who understand their limits when riding on public streets and highways. Non-traditional track courses provide a safe, fun environment where riders can learn to find their personal limits.

4. Cost Benefit Analysis: Making the Training Worthwhile

The two most important assets in a military organization are people and capital. Both the Navy and Marine Corps seek to utilize their manpower and capital effectively. In terms

of motorcycle training, the Navy and the Marine Corps aspire to gain effective training for motorcycle riders through efficient spending (best bang for the buck). The best indicator of effective motorcycle training is a decrease in the number of motorcycle accidents and fatalities. The increase in motorcycle incidents over the past nine years indicates that the current approved motorcycle safety training may not be as effective as the services had intended. Therefore, it may be worth it to consider an alternative type of training in the form of non-traditional track courses. While there are no official studies indicating how effective non-traditional track courses are in reducing the number of accidents and fatalities, track instructors, and riders who have completed these courses, are convinced that the track courses better prepare riders for riding on the street. From a military standpoint, the non-traditional track courses should be effective enough to show a distinct decrease in the number of motorcycle accidents and fatalities in any given period. Based on the cost estimate for non-traditional track courses discussed in the previous section, the annual cost is assumed to be $3.2 million for the entire Department of the Navy. The reduction in the number of annual accidents and fatalities must be enough to offset the cost of the non-traditional track courses. The following formula illustrates how to determine an effective decrease in the number of accidents and fatalities.

Formula 4.

ΔF * Fatality Cost = Training Cost, where ΔF is the decrease in the number of fatalities.
ΔA* Accident Cost = Training Cost, where ΔA is the decrease in the number of accidents.

In 2008, there were 58 fatalities and 423 accidents throughout the Department of the Navy. The monetized cost for Department of the Navy motorcycle fatalities was $23.2 million, while all accidents cost the Department of the Navy $30.4 million. Using these figures, the necessary reduction in the number of accidents and fatalities was estimated. Table 19 presents the estimated results.

Table 19. Cost Benefit Analysis for Non-traditional Motorcycle Training

Non-traditional Training Cost Benefit Analysis					
	Dept. of the Navy	**Monetized Cost**	**Training Cost**	**Delta**	**Effect**
Fatality Cost	58 fatalities	$ 23,200,000	$ 3,200,000	13.79%	8 lives
Accident Cost	423 accidents	$ 30,418,293	$ 3,200,000	10.52%	45 accidents

For the non-traditional track courses to be considered effective and worth pursuing, the Department of the Navy would be looking for at least a 13.79 percent decrease in the number of motorcycle fatalities, or a 10.52 percent decrease in the number of motorcycle accidents in a 1-year period. These two percentages indicate that the Department of the Navy should consider non-traditional track courses to be a worthwhile investment if the training effect decreases the number of motorcycle fatalities by eight or more, or decreases the number of accidents by 45 or more.

H. SELECTING SERVICE MEMBERS FOR TRAINING

Since the military does not have unlimited time or funds to dedicate to motorcycle training, a systematic approach to selecting the Sailors and Marines who will be offered non-traditional motorcycle training must be used. The motorcycle accident data provided by the Naval Safety Center indicate that the Sailors and Marines ranging in the 17- to 29-year age group are the service members who will most likely be involved in motorcycle accidents. Service members who fall in this age group category should be given the highest priority as far as training is concerned in order to minimize the risk of death or serious injury. Sailors and Marines who have already been involved in motorcycle accidents should be given the next highest priority. Traditionally, those service members who have had an accident are more inclined to be involved in more motorcycle accidents. Multiple accidents may indicate more risky behavior on the part of the service member, which is precisely the type of behavior that track day training is used to curtail. Service members who ride motorcycles, and who are returning from deployment should be next on the priority list to receive the non-traditional motorcycle training. These returning

riders who have spent the last several months unable to ride a motorcycle, in most cases, may have significantly diminished riding skills. The non-traditional motorcycle courses may help to bring Sailors and Marines up to speed quickly in terms of skill in one full training day. The track day training provides an environment that promotes realistic training at minimum risk to the rider, and serves as the fun way to acquire the skills to become a better street rider.

As military organizations, the Navy and the Marine Corps desire to provide the most effective motorcycle safety training for Sailors and Marines. In most cases, the services mandate that Sailors and Marines must complete the approved motorcycle safety training within a specific time period. The Motorcycle Safety Foundation's (MSF) Basic Rider Course (BRC) and the Military Sport Bike Rider Course (MSRC) are both mandatory courses, while the Experienced Rider Course (ERC) is not mandatory, but highly recommended. All three courses are provided by the same organization, essentially creating a monopoly on motorcycle training in the military. This point raises one very important issue: What motivates the MSF course organizers to provide Sailors and Marines with the best possible training considering that (1) the organization has a monopoly on motorcycle safety training not only in the military, but nationwide as well, and (2) the Department of the Navy has made the course mandatory for riders? The short answer: Nothing. By making the motorcycle safety courses mandatory through a single provider, the Department of the Navy has become a captured audience to the MSF. One way to deal with this issue is to allow the rider to select the type of training he or she believes is best suited to his or her motorcycle type and riding style.

The MSF's BRC is recognized nationwide as the main provider of motorcycle safety training for the novice rider. While arguably not the best training available, the MSF's BRC is recognized by most state Departments of Motor Vehicles (DMV) as sufficient training in earning a motorcycle license. Understandably, the military is in a position where they will have to continue using the MSF's BRC to train novice riders. However, since there are multiple avenues available for providing follow-on motorcycle safety training for Sailors and Marines, the Navy and Marine Corps could exercise the option of allowing the individual Sailor or Marine to choose among the ERC, the MSRC,

and non-traditional track courses. This option allows the Navy and Marine Corps to address several issues. By giving the individual Sailor or Marine the choice of follow-on motorcycle safety training:

- Sailors and Marines will opt for the type of motorcycle safety training that they believe is worth their time.
- Sailors and Marines will opt for the training that best suits their motorcycle type, and the riders' riding style.
- Sailors and Marines will form their own opinion on whether or not a particular type of training was helpful in providing them with better riding skills.
- Risk takers may naturally gravitate to the non-traditional track courses. This is one of the target groups that may need help in improving skill and overall rider attitude.
- Motorcycle training organizations would ensure they provide the riders with the best possible training in order to remain competitive among similar organizations, and attract more customers.

Giving the Sailor or Marine the opportunity to choose a preferred type of follow-on motorcycle safety training comes at no extra cost to the Navy or Marine Corps. Essentially, the services would spend the same annual amount on motorcycle safety training with the same number of Sailors and Marines completing their choice of motorcycle safety course. In fact, the Navy and Marine Corps could possibly spend less if more riders opt for the non-traditional track courses, since a majority of the track organizations provide both military and group discounts.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

The Navy and Marine Corps lose thousands of hours of manpower due to motorcycle related injuries and fatalities on an annual basis. Along with the loss of manpower, the secondary effect of motorcycle related injuries and fatalities, is the millions of dollars spent on hospitalization costs and life insurance. Both Navy and Marine Corps leadership have recognized that motorcycles pose a serious threat to operational readiness and manpower in terms of people and money, the services' most precious assets. This research analyzed how motorcycle accidents affect manpower and mission readiness in the Navy and Marine Corps. One of the objectives of this study was to examine whether the current approved motorcycle safety training used by the Navy and Marine Corps is best suited to reduce motorcycle accidents, injuries, and fatalities. Another objective of this study is to help Navy and Marine Corps decision makers select motorcycle training that is more effective in reducing motorcycle related manpower losses. The research was intended to answer the following questions:

- How do motorcycle accidents affect mission readiness in the Navy and Marine Corps?
- What are the primary causes of accidents in the Navy and Marine Corps?
- How are Sailors and Marines selected for training for motorcycle training courses?

The literature review highlighted several studies that sought to determine the main causes of motorcycle accidents, and whether or not the current traditional courses being offered were serving the intended purpose of reducing motorcycle accident and fatalities.

Professor Hugh Hurt's 1981 study highlighted the need for a motorcycle safety course, and named the Motorcycle Safety Foundation's Motorcycle Rider Course as the most effective way to reduce motorcycle accidents and fatalities.

A later study, conducted by Team Oregon, determined that the Motorcycle Safety Foundation's Basic Rider Course, a later version of the Motorcycle Rider Course, did not satisfy the needs of the novice motorcycle rider.

Other studies highlight the fact that hospitalization costs associated with motorcycle related injuries would be substantial when considering the average 10-day length of stay for motorcyclist requiring hospitalization.

This thesis used several analysis tools to determine the probability of accidents resulting in injuries or fatalities. The thesis also analyzed the cost of recruiting and training individuals for military service, and the cost of life insurance and hospitalization as a result of motorcycle accidents.

Probit regression models were used to estimate the probabilities of a Sailor or Marine being involved in a motorcycle accident that resulted in death or injury causing the individual to miss work. The regression results highlighted that there were consistencies among the models used to estimate those probabilities. The estimated probabilities of fatality or injury, and the significant variables are presented below.

- Operating a sport bike increases an individual's probability of being killed, if in an accident, by approximately 6 percentage points.
- For a rider who is in an accident, approved motorcycle safety training initially reduces that rider's probability of having an injury that requires time from work by approximately 10 percentage points.
- For a rider who is in an accident, approved motorcycle safety training increases the rider's probability of being killed by approximately 3 percentage points.
- If a rider is involved in a motorcycle accident, there is a 10 percent probability of the rider being killed even if the rider has completed approved motorcycle safety training.
- If a rider is involved in a motorcycle accident, there is an 87 percent probability of the rider sustaining injuries that require time from work even if the rider has completed approved motorcycle safety training.

The motorcycle accident data and the results of the probit regressions are inconclusive in determining the effects motorcycle safety training has on reducing the probability of accidents and fatalities in the Navy and Marine Corps.

The Navy and Marine Corps spend millions of dollars to recruit and train service members for various military occupational specialties (MOSs). Recruiting costs can range from $10,000 to $13,000 per individual. In training service members, some occupational specialties can cost the military up to $163,000 per individual. When a Sailor or Marine is killed or injured in a motorcycle accident, the services suffer manpower and training investment losses. The individual Sailor or Marine will be unable to fulfill his or her military contract due to loss of life, or extended period of absence from work. The cost situation is exacerbated because of additional costs to recruit and train individuals to replace those killed or permanently injured in motorcycle accidents.

Life insurance covers a large proportion of the monetized costs associated with fatal motorcycle accidents. Service Member Group Life Insurance (SGLI) is likely to pay up to $400,000 per member, to the families of those killed in a motorcycle accident while on active duty. The data from the Naval Safety Center indicate that less than 20 percent of the motorcycle accidents result in rider fatality, while greater than 50 percent result in injury requiring time from work. The average hospitalization period for injuries due to a motorcycle accident is estimated at 10 days, accruing a cost of approximately $22,000 per person. The monetized cost associated with motorcycle accidents in the Navy and Marine Corps for 2008 alone was $18.2 million and $12.2 million, respectively. Analysis also indicates that individual Sailors and Marines who are involved in motorcycle accidents, could accrue an investment ranging from approximately $50,000 to $570,000 depending on their occupational specialty and severity of injuries. These figures do not account for the cost of lost man-hours or the cost of rehabilitation, which would depend on the exact period each service member is absent from work, the service member's pay grade, work lost during rehabilitation, and the cost per hour of rehabilitation.

This thesis highlights that the traditional MSF courses and the non-traditional track courses have relatively the same costs. The difference is reflected in the value of realistic training and practice provided by a non-traditional track course. Historically, track day riders are better street riders because of the experience learned from a full day

of instruction and riding on the track. Track day organizations provide fairly flexible event schedules that will normally fit various personal schedules and budgets. Track day training is not limited to sport bikes only.

B. CONCLUSIONS

Over 48,000 Sailors and Marines ride motorcycles, and about 45 percent of them ride sport bikes. Though only a small proportion of riders are involved in motorcycle accidents annually, that small percentage has gained a great amount of attention and accrued a fairly large bill in the process. In 2008, the equivalent combined monetized cost for motorcycle related injuries and fatalities in the Navy and Marine Corps totaled just over $30 million. More than 70 percent of all Sailors and Marines involved in motorcycle accidents were operating sport bikes. About 12 percent of those accident victims died, and more than half of the accident victims had accident-related injuries that prevented them from performing their jobs.

The Navy and Marine Corps have mandated that all motorcycle riders complete an approved motorcycle safety course. Each service ensures that Sailors and Marines are afforded the opportunity to complete approved motorcycle safety training at no cost to the individual. This study indicates that the current approved motorcycle safety courses may not be the right courses for Sailors and Marines, and may not be enough to effect a reduction in the number of annual motorcycle accidents, injuries, and fatalities. Sailors and Marines are attempting to merge into traffic and ride at designated speed limits when they have not been taught to merge or ride at traffic speeds. The number of reported motorcycle accidents reached 259 in the Navy and 164 in the Marine Corps in fiscal year 2008. Based on these figures, it is fair to assume that if the type of training offered is not overhauled in the right way, more Sailors and Marines will be injured or will die as a result of motorcycle accidents on public roads and highways.

When a Sailor or Marine is injured or killed in a motorcycle accident, each service experiences a loss of manpower, negative return on individual investment, and potentially a substantial loss in readiness. In order to make a difference in reducing the number of accidents and fatalities the Navy and Marine Corps need to explore other

training alternatives such as track day events. Motorcycle experts believe that riders can learn and experience more from one track day training event than from years of riding on the street. The intent of the training is to reduce motorcycle accidents and fatalities in the Navy and Marine Corps and in doing so reduce losses in manpower, reduce financial costs for each service, and improve readiness.

The thesis research conclusions are limited by factors associated with the data used in the separate analyses. First, we have no data on the effect of motorcycle training on the probability of having a motorcycle accident. Second, both the Navy and Marine Corps motorcycle accident data contained missing observations for several regression variables. The Navy motorcycle accident data was more complete than Marine Corps motorcycle accident data, and highlighted some inconsistencies in the method of data collection. Had this missing data been available, more precise probability estimates may have been determined. Missing data may limit the full effect of the regression results. Third, the use of average hospitalization cost, and average length of hospital stay may bias the cost estimates. Actual hospitalization costs depend not only on the number of days spent in a hospital facility, but also on the type of injuries the riders sustain, and whether there were surgeries involved as a result of the injuries. Rehabilitation costs were also omitted. The motorcycle accident data did not provide information on individual injury type or hours of rehabilitation for the purpose of calculating actual cost. One conclusion that can be drawn, based solely on the motorcycle accident data, is that sport bikes pose a greater threat to service members than any other motorcycle type, regardless of pay grade or occupational specialty.

Motorcycles can be extremely dangerous in the hands of a Sailor or Marine who does not understand his or her own capabilities on a motorcycle, or the capabilities of the motorcycle. Some Sailors and Marines may not have grasped the reality that riding a motorcycle is a daily commitment to learning something new. Effective, realistic training makes owning and riding a motorcycle much safer and much more fun. Motorcycle training that is not on par with the motorcycles being purchased and ridden is less than effective. The phrase “we train the way we fight” is often used in the Navy and Marine Corps in reference to training for military operations. This phrase should apply to any

form of training that involves Sailors and Marines, including motorcycle training. Ill-prepared motorcycle riders on the street are the same as ill-prepared service members in combat. Their chances of survival are significantly reduced. Mandating the right training for the right rider ensure Sailors and Marines get the opportunity to make it to the fight.

The data and the corresponding analyses highlight that motorcycles accidents have been a serious issue in the Navy and Marine Corps over the past decade. The current approved motorcycle safety training offered to Sailors and Marines provides the basics of riding a motorcycle. Unfortunately, in the age of the technologically enhanced street bike, the basics alone may not be enough to prevent valuable loss of our talented service members to unnecessary motorcycle accidents.

C. RECOMMENDATIONS

The capabilities of the latest motorcycles have far surpassed the level of skill being taught by the safety courses the military require today. Sailors and Marines are in need of a better motorcycle safety course that will provide them with better rider training, and ultimately better riding skills. Furthermore, the constant fluctuation in gas prices over the last few years, and the possibility of increased gas prices, may result in an influx of Sailors and Marines trading in four-wheeled vehicles for motorcycles. In order to make an impact in reducing motorcycle injuries and fatalities in the Navy and Marine Corps, the following actions are recommended:

- Incorporate a lead/follow street ride portion within the allotted curriculum hours of the current approved motorcycle safety courses. This gives motorcycle safety instructors the opportunity to demonstrate riding on the street and evaluate students' ability to handle the street environment. The instructor may then make a determination as to whether or not the student is ready for the street environment or need further instructions in order to safely operate on public roads.
- Establish data collection repositories in order to conduct further studies that capture and compare the differences in behavior, skill, and accident trends in Sailors and Marines who have track day experience versus those who do not.

- Track the costs of life insurance, hospitalization, and rehabilitation due to fatalities and injuries caused by motorcycle accidents to get a better sense of how important the correct training is to reducing cost.
- Provide Sailors and Marines the option to choose among the ERC, MSRC, or a non-traditional track course. Allowing Sailors and Marines to select the training that best suits their motorcycle type or riding style helps student riders to become more involved in the type of training they receive. Sailors and Marines will opt for training that they determine is worthwhile, and hence be more attentive. Additionally, allowing Sailors and Marines to choose their preferred motorcycle safety courses enables the Navy and Marine Corps to add another training option at no extra cost.

Based on the verbal discussion of non-traditional motorcycle safety courses the following additional actions are recommended:

- Consider signing contracts with reputable non-traditional motorcycle training organizations to provide Sailors and Marines with follow-on training at no cost to the service members. This will minimize the number of Sailors and Marines awaiting training, as well as reduce the number of days Sailors and Marines are delayed before attending training. Additionally, competition among different motorcycle training organizations motives them to provide the best training for Sailors and Marines. Most of these organizations already incorporate lead/follow techniques, and video footage feedback within their curriculum.

One important issue that warrants discussion is whether providing mandatory motorcycle safety courses funded by the military motivates riders to participate with the true intention of learning. A motorcycle safety course that keeps riders fully engaged in the curriculum is capable of providing those riders with the knowledge and skill needed to operate a motorcycle. The problem lies in the individual Sailor or Marine whose passion for riding and learning to ride differs greatly from person to person. Each person's attitude toward the safety course determines the value that person generates from the course. Taking into account that Navy regulations mandate that a course is taken, and that the individual rider does not pay for the course, further complicates determining whether riders value the training they receive. Some riders may find a wealth of value in one course, while others merely tolerate the same course for the purpose of fulfilling a requirement. Giving the riders the option to choose the course that is most compatible with their riding style may only slightly alleviate this problem. Only the riders who are truly motivated to learn new skills would find value in any of the

courses. There is no definite answer associated with the question of rider motivation towards a mandatory course funded by the military. The lack of a definite answer undermines the previous recommendations. These recommendations are highly dependent on rider motivation towards learning.

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